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The World Bank

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Report No. 3292-KO

STAFF APPRAISAL REPORT

KOREA

FIRST WATER SUPPLY PROJECT

November 13, 1981

Regional Projects Department
East Asia and Pacific Regional Office

CURRENCY EQUIVALENTS

Currency Unit	=	Won (W)
Won 1.00	=	US$0.00151
US$1.00	=	W 660

MEASURES AND EQUIVALENTS

mm	=	millimeter	=	0.04 inches
cm	=	centimenter	=	0.39 inches
m	=	meter	=	3.28 feet
km	=	kilometer	=	0.62 miles
sq km	=	square kilometer	=	0.39 square miles
ha	=	hectare	=	10,000 square meters or 2.47 acres
cu m	=	cubic meter	=	264 US gallons
cu m/s	=	cubic meters per second	=	22.8 million US gallons per day
l	=	liter	=	0.26 gallons
lcd	=	liters per capita per day	=	0.26 US gallons per capita per day
mg/l	=	milligrams per liter	=	parts per million
m/s	=	meters per second	=	3.28 feet per second

PRINCIPAL ACRONYMS AND ABBREVIATIONS

ADB	-	Asian Development Bank
EPB	-	Economic Planning Board
FAO	-	Food and Agricultural Organization
ISWACO	-	Industrial Sites and Water Resources Development Corporation
MHA	-	Ministry of Home Affairs
MOC	-	Ministry of Construction
MOHSA	-	Ministry of Health and Social Affairs
OOE	-	Office of the Environment
UNDP	-	United Nations Development Program
WHO	-	World Health Organization

Fiscal Year

1 January - 31 December

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The project was prepared by the Water Supply Bureaus of the Municipalities of Gwangju, Daegu, Masan, Changwon and Jinhae, appraised by Messrs. Saravanapavan and Mejia in September/October 1980 and updated by Messrs. Saravanapavan, Tsui and Smith (consultant) in July and October and by Saravanapavan and Fernandez in November 1981.

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1. THE SECTOR

Background

1.01 Information on the water supply and sewerage sector is varied in its reliability and adequacy because of the several institutions with differing degrees of competence that are involved in the sector at the state and local levels. There is also a general lack of coordination among these institutions due to the disorganized state of the sector resulting in water resource management problems. Increased population densities in the metropolitan areas resulting from rapid economic growth are associated with some of the more critical environmental problems due to the burdens placed upon the environmental assimilative capacities of the affected regions by industrial, municipal, and domestic waste discharges, and by a rapid increase in vehicular traffic. However, adequate sector information exists, especially in regard to the urgent need to expand water supplies for municipal and industrial needs in major cities of the country and the hazards to health caused by pollution of the country's water resources, to provide a justification for the first water supply project, which also makes a start in correcting the organizational weaknesses.

Water Resources

1.02 The Republic of Korea is situated in the southern part of the Korean peninsula and occupies a land area of 98.9 thousand sq km. About two thirds of the land is mountainous and largely unsuitable for cultivation. There are ten major river basins in the country which account for 75% of the land area and of these the basins of the four largest rivers, the Han, Nagdong, Keum and Yongsan comprise 66% of the land area. Rainfall averages about 1,000 mm per annum mostly occurring between April and September, when floods are common. The climate is characterized by dry and cold winters, warm summers and cyclical droughts. Multipurpose dams have been constructed, or are in the course of construction in four of the river basins to reduce flooding and also to store water for municipal and industrial needs, agriculture and power generation.

The Environment

1.03 Korea's industrial development and simultaneous rapid urbanization has been responsible for a noticeable decline in the quality of the environment because of increasing water, soil and air pollution. Several streams, rivers, estuaries and bays have been grossly polluted from the discharge of untreated or partially treated municipal and industrial wastes

and urban runoff. Soil pollution, caused by herbicides, pesticides, application of night soil, municipal solid wastes and industrial sludges, sometimes with toxic materials and through runoff, pollutes both surface and ground water supplies. Dissolved oxygen concentrations below 4 ppm - the levels at which most aquatic life would not survive - have been measured in the Han and Nagdong Rivers. Fish kills have been reported in coastal waters off Ulsan, Masan and Jinhae. The major air pollutants are sulphur dioxide, suspended particulates, carbon monoxide, nitrogen oxides, hydrocarbons, heavy metals and fluorides. The Korean standard for long term exposure to sulphur dioxide is based on an averaging time of 24 hours. According to this standard, the daily arithmetic mean should be less than 0.05 ppm for more than 225 days per year. This standard was exceeded in Seoul in 1979 by more than 100% and in Busan by more than 16%. For comparison the annual average primary standard in the US is 0.03 ppm.

Public Health

1.04 Threats to health exist not only from air pollution but also pollution of the water supply in some urban and industrial areas by heavy metals and carcinogens. Water borne diseases such as dysentery, typhoid fever and cholera are prevalent. In the summer of 1980 there was an increase in the incidence of cholera in the project cities of Gwangju, Daegu and Masan. Intestinal parasitic infections are prevalent in farming areas where nightsoil is commonly used as fertilizer.

Population - Growth and Distribution

1.05 Overall population growth is expected to remain at the 1.9% per annum recorded during 1970-78. The population, as of December 1979, is estimated at 37.4 million and projected to rise to 50 million by 2000. Migration to urban areas, which resulted in an average urban growth rate of 5.2% during 1970-78, is expected to be less rapid in the 1980s, with the urban population levelling off at about 80% of the total population by the end of the century.

Sector Organization

1.06 There is no single agency in charge of overall planning and programming of the water supply, sewerage and sanitation sector. At the central government level five institutions, which are directly involved in the sector in various ways, often overlap with each other. These are: the Ministry of Construction (MOC) for industrial and regional projects and general sectoral planning; the Ministry of Home Affairs (MHA) for the smaller cities also making sectoral plans; the Ministry of Health and Social Affairs (MOHSA) for simple rural schemes; the Office of the Environment (OOE) charged with developing control strategies for protecting air and water quality including night soil treatment plants and, finally, the Economic Planning Board (EPB) for obtaining external loans. In addition there are some "special" cities with

varying degrees of autonomy carrying out development works in the sector. For example, the two largest cities, Seoul and Busan are almost completely independent and carry out sector development with little or no consultation with institutions at the provincial or central government level. In the absence of national priorities, each Ministry or special city prepares its own plans and implements projects. Tariffs are set by the Government through MHA. To upgrade the organization of the sector, Government agreed during negotiations to set up by not later than June 30, 1982 an interministerial committee in the MOC to study and make recommendations for improving coordination between the institutions and for the long-term rationalization of sector. Assurances were also obtained during negotiations that such a committee would be established under terms of reference satisfactory to the Bank not later than June 30, 1982 and the study would be completed and its findings discussed with the Bank, before its recommendations are implemented, in consultation with the Bank by not later than June 30, 1983.

Population Served-Water Supply

1.07 The quality of service of piped water supply is generally poor because most of the water utilities have not kept pace with the rapid urbanization and population growth. The fringe areas of many cities suffer from restricted supply, water rationing and frequent low pressures. The fluctuating pressures and high leakage - with unaccounted for water of the order of 40% to 50% - together with the discharge of sewage effluents into street drains and consequent infiltration makes the quality of the water in the distribution systems in most cities generally unsafe. Except for the rural systems, the treated water is chlorinated before distribution. However, because of poor operational standards the required optimum doses are not consistently maintained. The proposed project provides for improving operations in the five cities.

1.08 At the end of 1979, out of the national population estimated at 37.4 million, about 26.7 million (71%) living in both urban and rural areas were served by piped systems./1 In the urban areas 54 communities with populations of 50,000 and over - including the capital city of Seoul with a population of 7.8 million - had 85% served with house connections; 81 communities with populations between 50,000 and 20,000 had 49% served with house connections; and 97 communities with populations under 20,000 and above 1,000 had 39% served. However, though 79% of the urban population had house connections the quality of the service was poor. The few public standposts that exist are metered and charged a subsidized rate. In the rural areas, out of 32,600 villages, each with more than 20 households with a total population of 9.5 million, 72% had simple piped systems, serving 6.9 million.

/1 UN data for 1976: of total population 62% were served with water supply and 61% were served with excreta disposal facilities.

Of this population about 90% were provided with private taps - with most of the remainder using public standposts and/or shallow wells. Studies to prepare a future water supply project will be aimed at increasing coverage to those communities with service levels below 50%, and raising standards in rural areas. The proposed project includes such communities with a mix of medium sized and large towns in four or more regional studies.

Population Served - Waste Water Disposal

1.09 In a sample of cities with populations over 50,000 only 22% of the dwellings had flush toilets in 1979; the rest used night soil collection systems. Except for the two biggest cities - Seoul (7.8 million) and Busan (2.7 million) which treat a part of their domestic sewage - most of the waste water derived from septic tank effluents, domestic use and urban runoff is discharged, untreated, into the surface waters. There are also vault privies with night soil collection and treatment facilities in 40 large cities serving a population of 20.8 million. In 1976, 61% of this population were served with excreta disposal facilities. Night soil is used as a fertilizer after composting with rice husks in the rural areas. Currently there is a move away from night soil treatment plants to conventional sewerage in some of these cities, where municipal and domestic wastes pose a serious threat to the water supply.

1.10 In addition, there are about 16,000 industrial plants in the country generating pollutants that require disposal. Of these about 2,000 discharge industrial waste waters, often toxic in nature, consisting of organic materials, heavy metals, oils, acids and synthetics into the four major river basins. In terms of organic loadings it is estimated that 42% of water pollution is due to municipal sewage and night soil, 45% to industrial wastes and 13% to agricultural runoff. The OOE is preparing to study pollution in two of the country's most important basins, the Han and Nagdong River Basins. The Asian Development Bank (ADB) will be assisting with studies of the Han River Basin following which OOE will undertake the Nagdong River Basin studies. An understanding was reached during negotiations that the Nagdong studies for which the draft terms of reference have been reviewed by the Bank and are satisfactory, will be completed by December 31, 1986 which is in time to accommodate detailed design for the next stage expansion of the Daegu and Masan water supply which draw from the Nagdong River.

Past Investments in the Sector

1.11 Data on sector investments have been analyzed as best as possible since none of the agencies referred to in para. 1.06 produce complete sector statistics or even comparable data covering the same subsector. In the Government's Fourth Five-Year Plan (1977-81) W 181.9 billion was allocated for public works in the sector and W 62.9 billion (1975 prices) for health and environment. Actual expenditure up to the end of 1980 was about 66% of plan targets and by the end of the plan period investment is estimated to

reach only 75% of planned amounts. For regional water supplies and metropolitan sewerage, about W 30 billion and W 29.0 billion respectively were provided in the Plan but no major investment had been made up to end 1980. Out of the 9 provinces in the country and the two special cities of Seoul and Busan, per capita investment ranged from W 4,749 in Seoul and W 3,334 in Busan to W 648 in Chungcheong Nam province. With the exception of Daegu, there has been no major investment under the Plan in the five cities included in the proposed project.

The Fifth Five-Year Plan

1.12 The Government's policies for the sector in the next Plan (1982-86) include preservation of water quality, replacing obsolete equipment and pipelines and investments for sewerage together with the institution of policies for cost recovery of sewerage services. As an example of the sectoral organization problems discussed earlier, both MOC and MHA have produced different programs for sectoral investments in the Fifth Plan. MOC has approached the task by setting targets (for 1986: population served 80%, demand 300 lcd, system losses 38%, etc.) to provide a basis for arriving at the investments required for city water supplies and for regional schemes, which aggregate to W 1,092 billion. MHA has come up with an investment plan of W 1,390.8 billion, about 20% higher than MOC's estimate. The basis of MHA's estimate is not known. The approved investment program is W 486.0 billion (1980 prices) which is approximately two- and one-half times as much as the Fourth Plan budget.

1.13 MOC has long term goals for sewerage service levels in about 36 cities: it aims at providing service to 25%, 30% and 50% of the population of those cities by 1986, 1991 and 1996 respectively. In general, it is planned to provide sewage treatment facilities by 1986 to cities (including industrial areas) with populations of over 0.3 million and to other smaller cities by 1990. The proposed plan is ambitious, and it does not provide for investment in separate sanitary sewage collection systems without which sewer service cannot be provided and costs recovered. Work has, however, started in three cities, partly with ADB funding, for the construction of sewage treatment plants.

1.14 No investments for environmental pollution abatement are envisaged in the Plan, except for the studies of the Nagdong River and Han River Basins. It is expected that by about 1984 and 1986 these studies would have identified projects which will require priority investments.

Manpower

1.15 There is a lack of basic information on availability of manpower in the sector and on training needs. A survey will be made by the Government in the context of national planning by MOC and OOE to identify manpower resources (water supply, waste water treatment and environmental protection) their utilization, future needs, competing demands and the

factors which give rise to attrition. Assurances were obtained during negotiations that the survey would be conducted under terms of reference acceptable to the Bank and completed by December 31, 1982, and following discussion with the Bank provide a basis for the training programs in the proposed project, in accordance with an implementation schedule acceptable to the Bank.

Bank Lending in the Sector

1.16 The Bank's Kyongju Tourism Project (Loan 953-KO) and the Second Regional Development Project (Loan 1758-KO) included water supply components for Kyongju, Mogpo and Yeosu Cities. The Bank's Rural Infrastructure projects Loan 1216/18-KO and Loan 1530-KO included about 11,400 simple rural piped water systems. No evaluation of these projects has yet been prepared. The Bank's strategy in the sector is to help government develop a least cost investment program for improving water supply, sewerage sanitation and environmental pollution abatement facilities and to provide technical assistance and training for institution building and staff development. The Government is preparing a second water supply and sanitation project for 1984. Water supply and sanitation investments will also be included in the Regional Development Project proposed for Korea's Jeonju Region.

2. THE BORROWER, EXECUTING AGENCIES AND BENEFICIARIES

The Borrower

2.01 A Bank loan of $90.0 million is proposed. The Borrower will be the Government of the Republic of Korea which will relend $86.5 million on the same terms as the Bank loan, plus a service charge of 0.05% per annum, to the five municipalities of Gwangju, Daegu, Masan, Changwon and Jinhae to finance their respective water supply subprojects. The execution of a subsidiary loan agreement acceptable to the Bank, with each city, will be a condition of disbursement of the Bank loan for expenditures on the project (see para. 4.07). The Government will allocate the balance of the loan to the Ministry of Construction ($3.5 million) for project preparation studies, manpower development and staff training.

Executing Agencies

2.02 The coordinating agency for the water supply subprojects will be the Water Resources Bureau of the Ministry of Construction, which will also be responsible for preparing future water supply projects. The Bureau is being strengthened to make it more effective in performing such functions as project preparation; monitoring performance of project construction; loan administration and ensuring that the various subprojects are completed by

the five cities as scheduled. The Water Supply Division of the Bureau has already gained some experience in the preparation and implementation of water supply projects financed by the ADB, and no special problems are anticipated. Nevertheless MOC requires additional training in preparing projects using appropriate techniques for achieving a least cost solution. The proposed project will provide on-the-job training in these areas. The Water Resources Bureau's organization structure /1 relative to its functions in water supply and sewerage is shown in Chart 22312. The adequate strengthening /2 of the Bureau would be a condition of effectiveness of the proposed loan (see para. 4.12).

2.03 The Office of the Environment (OOE) will be responsible for the environmental management study of the Nagdong River Basin and for the preparation of environmental projects. OOE was established under the Ministry of Health and Social Affairs on December 29, 1979 and charged with the execution of the Environmental Preservation Law of December 31, 1977. This legislation is satisfactory and OOE, in its brief existence of one year, has made adequate institutional arrangements to enable it to undertake the Nagdong River Basin studies.

Beneficiaries

2.04 The main beneficiaries of the proposed project will be the five cities of Gwangju, Daegu, Masan, Changwon and Jinhae. These cities, which were selected by Government for rapid industrial development, are growing at a fast pace (total projected population of 3.9 million by 1985) and are currently experiencing water shortages, of which the most serious are in Gwangju and Masan. Master plans and feasibility studies have been prepared for water supply expansion and it is projected by the consultants that by 1985, almost 90% of the population of these cities, of which 5 - 10% would be urban poor, would be served with water.

Organization and Management

2.05 The Water Supply Bureaus of Gwangju and Daegu will be responsible for project construction in these two cities. Because of the special nature of the regional municipal bulk water supply scheme, Masan's Water Supply Bureau will construct the major facilities for the three cities of Masan, Changwon and Jinhae. The Mayor of Masan is organizing a special Project Office in the Masan Water Supply Bureau for this purpose. The three cities are about to enter into a Regional Management Agreement by which Masan would appoint consultants, award contracts, supervise construction and

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/1 Based upon latest information

/2 The selection of one water supply engineer and two financial analysts is considered the minimum required.

operate the bulk municipal water supply facilities (see para. 4.13). The installation of house connections, production metering, local distribution improvements, upgrading works, including improved plumbing practices and leakage surveys would be the responsibility of the individual cities.

2.06 In order to maximize the economic utilization of water resources the Government has ensured that all capital works in the sector require clearance by MOC. Future water supply investments in Masan Region, both in the proposed municipal water supply schemes and the existing industrial water supply system would be made only after careful technical and economic reviews by MOC./1 This will have the benefits of lower costs for both industrial and municipal categories. Assurances were also obtained during negotiations that all major investments for municipal and industrial water supplies in the Masan Region would only be implemented with the Bank's prior approval on the basis of technical and economic reviews by MOC.

2.07 Four of the five cities suffer from frequent staff changes and a general lack of experience in dealing with problems in the sector. Daegu is the exception with highly motivated and competent management and staff. The proposed project will therefore include a component to provide engineering and financial consultants as well as staff training to assist the four cities. In the case of Gwangju City there is, in addition, a special provision for management services for the design and supervision of construction of a 43 m high rockfill dam (see Annex 1), since this city has little experience in the construction of large projects.

2.08 Gwangju, Daegu and Masan have Water Supply Bureaus responsible for the water supply operation. Chart 22313 shows a typical organization of these Bureaus. Each Bureau is headed by a Director who reports directly to the Mayor and enjoys limited autonomy. The Business Section is responsible for accounting, finance and commercial activities and the Construction Section is responsible for planning and implementing its expansion programs. This organizational structure is considered adequate.

2.09 Jinhae has a Water Supply Section and Changwon a Water Supply Subsection of the Urban Planning Section. Both municipalities are planning to convert the Sections to Bureaus when the volume of operations justify the upgrading. The best operated Bureau is the one in Daegu mainly because its Director has remained in that position for nearly seven years. He has implemented projects financed by AID and ADB. The Masan Bureau will be entrusted with the implementation of the projects for Masan, Changwon and Jinhae.

/1 The industrial bulk water supply scheme, known as the Majin System is owned by MOC and operated by the Industrial Sites and Water Resources Corporation (ISWACO) and serves industrial complexes in Masan region.

Accounting and Auditing

2.10 Water supply accounts are kept separate from the other activities of the municipality and funds generated are not transferred to other municipal activities. The Masan, Gwangju and Daegu water supply bureaus follow an accounting system designed by the Ministry of Home Affairs while the water supply sections of Changwon and Jinhae use municipal accounting guidelines provided by the provincial government. Neither accounting system is on a fully accrual basis: both are geared mainly to budgetary purposes. Accordingly financial reports are of limited use as management tools. Financial reports are prepared annually and the records kept up to date. Accounts for Masan, Daegu, Gwangju and Changwon are audited by independent private auditors and audit of Jinhae's accounts is conducted by the provincial government. The audited financial reports for 1980 have been reviewed and are of varying quality with many shortcomings. Financial planning is limited to budgets prepared annually for the following year and reviewed periodically.

2.11 During negotiations the five cities agreed: (a) to hire consultants under terms and conditions acceptable to the Bank to assist the municipalities introduce (i) required adjustments to convert the accounting system of their water supply operations to an accrual-based, commercial accounting system, (ii) financial planning, management and internal control systems which would provide for the compilation and control of statements of expenditure and are essential for the successful implementation of future expansion programs. Both accounting and financial systems should be in operation by December 31, 1983; (b) unless the Bank otherwise agrees, not to transfer the funds generated by the water supply operations to other municipal activities; and (c) to have their accounts audited by independent auditors acceptable to the Bank and to furnish to the Bank the annual audited financial statements and the auditors report to management within six months of the close of each year.

Billings and Collections

2.12 The five water supply systems are almost fully metered. Meters are read and bills prepared monthly. Except for Daegu which recently started to process bills by computer, all the water bureaus do the billing manually. Daegu's experience is being followed by the other cities to decide if they should also computerize billings in the future.

2.13 Collections are made through commercial banks and branch offices. Collection procedures are tight and are strictly enforced. Although the accounting systems make it difficult to determine accurately the level of accounts receivable outstanding, they are estimated to be equivalent to about 30 days of billings.

3. WATER DEMAND

General

3.01 Per capita water consumption in the two largest project cities of Daegu and Gwangju will be about the same, although Gwangju has a low consumption at present because of inadequate production facilities. Masan's consumption will reach the level of Changwon when the new Masan Satellite Industrial Town comes on line in about 1986. Jinhae's consumption is projected to be a little less than all of the others because there are no immediate plans for new industry; it serves as a dormitory town for neighboring Changwon and is a recreation center for the Masan region. In projecting demand, it is assumed that the economy will overcome the present recession and industrial growth will continue as planned in the project cities. The existing situation of the water systems is described in Annex 2.

3.02 Service Areas. The water supply service areas cover the municipalities of Gwangju and Daegu and the contiguous municipalities of Masan, Changwon and Jinhae; these latter three cities are referred to as the Masan Region. Changwon is a planned new city designed with the express purpose of encouraging industry. With the exception of a few residential suburbs in Daegu, the water supply development program to the year 2000 will take place mostly within the boundaries illustrated in Maps IBRD 15432 to 15434.

3.03 Population. The population projections for the service areas were based upon demographic variables of population by age and gender, death and fertility rates and migration, derived from historical population data. An important factor affecting growth is recent government policy to restrict the expansion of Seoul and Busan and divert industry to the five provincial cities of Gwangju, Daegu, Masan, Daejon and Chongju. This means more new manufacturing industries than anticipated in three of the project cities with corresponding changes in urban planning; some of these changes have already been made, for example, Masan has made firm plans to build a satellite town to accommodate this policy. The corresponding growth rates are therefore high in the initial years of the project.

3.04 On the basis of these assumptions, upper and lower population growth curves were derived and curves near the median selected for design of the water supply systems. For Daegu the selected curve assumes an annual growth of 4.5% from 1978 to 1988; during that period its population is projected to increase from 1.49 to 2.31 million. Gwangju, in the same period would grow at 4.6% per annum with a population increase from 0.69 to 1.09 million. Because of the Changwon Industrial Complex, situated between Masan and Jinhae, the Masan Region is expected to achieve a very high rate of growth of 7% per annum until 1985 when the complex would be completed. Even after 1985, growth is expected to be a high 5% per annum until 1990, because of Masan Satellite Town. During the 1978-1988 period Masan would have grown from 0.39 to 0.60 million, Masan Satellite gained 0.19 million, Changwon grown from 0.07 to 0.29 million and Jinhae from 0.11 to 0.14 million. Should population increase follow the lower growth assumption the water supply systems would reach maximum capacities between 1986 and 1992.

Population Served

3.05 Population served with water in 1979 ranges from a high 92% in Daegu to 69% in Masan. Changwon was just being built and no statistics are available. The first stage of the project would improve the quality and level of service and in the face of high population growth would slightly improve coverage. At the end of 1985 population served will increase to 94% in Daegu, 86% in Gwangju, 77% in Masan, 76% in Jinhae and 83% in Changwon (see para. 3.10). These are reasonable targets since by the end of the decade Daegu would achieve 96% service coverage and the others about 90%. Without the project, the quality of service would rapidly deteriorate because of the rapid populatiion growth, and the possible recurrence of cholera would pose a threat to public health. The projected growth of industry in these cities would also be adversely affected.

3.06 Water Use. Field surveys were made in Daegu and Gwangju in 1979 to determine water use characteristics. The Gwangju survey based upon actual measurements of metered consumption, showed water consumption to be about 134 liters per capita per day (lcd) in middle income residential areas and 200 lcd in upper income residential areas. The Daegu surveys were based upon interviews supplemented by metered consumption data. Although there was no evidence of absolute poverty, some relative poverty was identified in the poorest sections of Daegu wherever this was possible, since generally small pockets of poor coexist with upper and middle level residences. According to the Daegu surveys, annual incomes in poor households were estimated to range from $1,180 to $4,800 with the number of persons per household ranging from 2 to 9 with an average per capita income of $493.90./1 The average per capita income of the middle income group was $1,177. Water use by the relative poor in Daegu averaged 77 lcd, the middle income residential 117 lcd and the upper income residential 175 lcd, a little lower than the findings in Gwangju. (See para. 6.06).

3.07 A limited leakage survey was carried out by the consultants in Gwangju. Though leaks at service connections were noted, no major losses from pipelines were detected. Meters were also found to over-register. In Jinhae, where most of the service connections are of plastic materials unaccounted for water was the lowest at 28%. Daegu, Gwangju and Masan with unaccounted for water at levels of 36%, 40% and 45%, respectively are preparing programs to reduce the level to 25% by 1985. It was agreed during negotiations that these programs which are to be implemented throughout the project period, would be sent to the Bank for review by June 30, 1982.

/1 This is higher than the average estimate for urban absolute poverty for the country of $320 for 1978. Daegu is a comparatively wealthy city and the higher per capita income is to be expected.

3.08 There are some 70 public taps (owned by the city and providing water to groups of more than 20 households) in Gwangju and 200 in Daegu. Daegu also has 138 common use taps (privately owned and providing water to groups ranging from 6 to 20 households). The numbers of these taps have been steadily declining and are expected to be phased out by 1990. Water from public and private taps is charged at a subsidized rate.

Water Production Estimates.

3.09 The projected water demand in each of the five cities was based upon (a) a study of the historical water consumption by different categories of users such as domestic, commercial, industrial and public use; (b) planned future growth in each user category; and (c) expected improved efficiency in operations with reduction in unaccounted for water. By 1985, on average, half the water consumption is expected to be for residental use, one quarter for commercial use, about 10% for industrial use and the remainder for other uses.

3.10 Between 1981 and 1983 water production estimates are indicative of the maximum system capacities and interim augmentation works undertaken in Daegu, Gwangju and Changwon. Water from the proposed project will enter the system in 1985 for Gwangju and in late 1984 for the other cities. Water production estimates and population projections for 1981 and 1985 are given below:

Table 3.1: WATER PRODUCTION ESTIMATES

	1981	1985
Daegu		
Population ('000)	1,697.0	2,024.0
Population served ('000)	1,557.1	1,883.6
Water production (litres/c/d)	209.0	236.0
Number of connections (thousands)	148.2	179.9
Gwangju		
Population ('000)	795.0	952.0
Population served ('000)	642.0	821.7
Water production (litres/c/d)	169.0	220.0
Number of connections (thousands)	60.0	83.0
Masan		
Population ('000)	442.0	544.0
Population served ('000)	304.7	418.7
Water production (litres/c/d)	148.7	186.0
Number of connections (thousands)	23.0	32.4
Changwon		
Population ('000)	143.2	240.0
Population served ('000)	51.1	175.1
Water production (litres/c/d)	136.0	202.6
Number of connections (thousands)	4.0	13.9
Jinhae		
Population ('000)	118.8	133.7
Population served ('000)	89.3	101.2
Water production (litres/c/d)	152.0	173.8
Number of connections (thousands)	9.8	11.4
Total		
Population ('000)	3,196.0	3,893.7
Population served ('000)	2,644.2	3,400.3
Population served (%)	83.0	87.3
Number of connections (thousands)	245.0	320.6

4. THE PROJECT

Project Objectives

4.01 The main objectives of the project are to improve access to safe water supplies to the populations in the five project cities, develop a strategy for improving the institutional organizanization of the sector and prepare priority water supply projects for the future.

Project Concept and Composition

4.02 Water supply improvements in most cities in Korea are often made in an ad hoc manner with minimum planning, inadequate preparation and financing, often leading to costly delays. In the case of this project, however, the concept and composition are unique because, in accordance with the Bank's advice, this is the first time that long-term master plans for water supplies have been prepared and feasibility studies made to select projects identified as being the least cost solution for staged implementation. With the institutional improvements proposed in the project it is expected that this approach would be adopted routinely in similar projects in the future.

4.03 The project was prepared in about 18 months by the Water Supply Bureaus of Gwangju, Daegu and Masan, and Water Supply Sections of Changwon and Jinhae with the assistance of consultants and was appraised in September/October 1980. The consultants for Daegu, Masan, Changwon and Jinhae were Stanley Associates Engineering Ltd (Canada) in a joint venture with Korean Engineering Consultants Corporation (SAEL/KECC). The consultants for Gwangju were initially Chas T. Main (USA) in a joint venture with Korean Engineering Consultants, Ltd. (CTM/KECL). These studies were subsequently reviewed and completed by SAEL/KECC with assistance from CTM/KECL. SAEL/KECC consultants are also preparing the detailed designs which are now substantially advanced and would be in sufficient detail for tendering purposes by the time of board presentation in December 1981. The local consultants KECC and KECL have gained valuable experience in the preparation of the studies. Because of difficulties experienced by the cities in obtaining foreign exchange to finance the foreign costs of the consulting services retroactive financing of $1.0 million equivalent, representing expenditures incurred after project appraisal is recommended.

Project Description

4.04 Detailed project descriptions for each city, which would be incorporated in the subsidiary loan agreements, are presented in Annex 3. The main features of the project are described below:

Part A - Municipal Water Supply Systems

(a) Source development including the construction of two river intakes, pumping stations for Daegu and Masan and the construction of a rockfill dam and pumping station for Gwangju;

(b) the construction of raw and treated water transmission systems including booster stations;

(c) the construction and upgrading of water treatment facilities;

(d) the construction and upgrading of water distribution systems including reservoirs, booster stations, pipelines, service connections and metering;

(e) leakage control;

(f) consultant services for engineering and construction supervision; and

(g) training.

Part B - Technical Assistance

This component will assist in the preparation of future water supply projects as listed below:

(a) consultant services for preparing water supply projects; and

(b) consultant services for manpower surveys and training.

Project Cost and Financing

4.05 Cost Estimates. The cost estimates made from the feasibility studies completed in September 1980 have since been revised on the basis of detailed surveys, field investigations and geologic studies for dam foundations, river intakes and treatment plant sites. For example, because of the detailed field survey a proposed 6.0 km of tunnel has been reduced to 1.8 km in Gwangju. This is further reflected in reduced physical contingencies for major civil works. The cost estimates are reasonable and project implementation can start shortly after loan approval. The summary project estimates are given below in Table 4.1. The detailed cost estimates are given in Annex 4 and the facilities to be constructed are illustrated in Maps IBRD 15432 to 15434. The foreign costs represent approximately 37% of the total construction cost. It is expected that Korean contractors will win all of the civil works contracts. A forecast of detailed design completion and bid dates is given below in Table 4.2.

4.06 Contingencies. The project cost estimates are calculated at a base line of September 1981 to which were added physical contingencies on local components of 25% for river intakes, 15% for Dongbok dam and other major civil works on source development except land and service connections

Table 4.1: SUMMARY OF PROJECT COSTS

	Local	Foreign	Total	Local	Foreign	Total
	--- (US$ million) ---			----- (W billion) -----		
Part A						
Municipal Water Supply Systems						
Daegu	35.29	21.76	57.05	23.29	14.36	37.65
Gwangju	51.76	29.42	81.18	34.16	19.42	53.58
Masan Region						
Masan	16.94	11.44	28.38	11.18	7.55	18.73
Changwon	8.53	6.12	14.65	5.63	4.04	9.67
Jinhae	2.14	1.46	3.60	1.41	0.96	2.37
Baseline Costs	114.66	70.20	184.86	75.67	46.33	122.00
Physical Contingencies						
Daegu	4.57	2.18	6.75	3.01	1.44	4.45
Gwangju	5.44	2.90	8.34	3.59	1.91	5.50
Masan Region						
Masan	2.29	1.14	3.43	1.51	0.76	2.27
Changwon	1.15	0.61	1.76	0.76	0.41	1.17
Jinhae	0.21	0.15	0.36	0.14	0.10	0.24
Subtotal	13.66	6.98	20.64	9.01	4.62	13.63
Price Contingencies						
Daegu	7.31	3.18	10.49	4.83	2.10	6.93
Gwangju	8.98	3.95	12.93	5.93	2.60	8.53
Masan Region						
Masan	3.38	1.34	4.72	2.23	0.88	3.11
Changwon	1.68	0.69	2.37	1.11	0.45	1.56
Jinhae	0.36	0.13	0.49	0.24	0.09	0.33
Subtotal	21.71	9.29	31.00	14.34	6.12	20.46
Total Part A	150.03	86.47	236.50	99.02	57.07	156.09
Part B						
Technical Assistance						
Preparation of second water supply project	0.37	3.03	3.40	0.24	2.00	2.24
Manpower development surveys and training	0.10	0.50	0.60	0.07	0.33	0.40
Total Part B	0.47	3.53	4.00	0.31	2.33	2.64
Total Project Cost	150.50	90.00	240.50	99.33	59.40	158.73

in Gwangju at 5%; 10% was added to all other categories. The project is to be constructed over a period of four years. Price contingencies were calculated at 14% for 1982 and 11% thereafter for the local component and 8.5% for 1982 and 7.5% for 1983 to 1985 on the foreign component.

4.07 Financing. The project cost, before interest during construction, is estimated to be $240.5 million including a foreign exchange component of $90.0 million. A financing plan for the project is given in Table 4.3. The proposed Bank loan will cover the foreign exchange component and represent 22% of the total financing requirements. The foreign exchange component of Part A is $86.5 million and represents 37% of the total cost of municipal water supplies. Government policy is to finance, through local loans, up to 50% of the local cost of each subproject; the municipalities financing the balance from city bonds and water tariff revenues. The Government would relend to the five municipalities $86.5 million of the proceeds of the loan under subsidiary loan agreements satisfactory to the Bank (see paras. 2.01 and 5.05). The foreign exchange risks will be borne by the individual municipalities. The loan amounts to the five cities are given below. There would be a provision in the Bank loan for reassignment as may be needed in the future.

	US$ million
Daegu	27.2
Gwangju	36.3
Masan	13.9
Changwon	7.4
Jinhae	1.7
Total	86.5

4.08 The Government would allocate from the balance of the proceeds of the loan, $3.5 million to MOC to finance the preparation of future water supply projects and consultant services for management, manpower survey and training.

Procurement and Disbursement

4.09 Civil Works. All of the major facilities in the construction program are suitable for international competitive bidding (ICB) and will be procured according to Bank Group's guidelines. Minor works, such as local improvements estimated at $7.7 million will be constructed at different times and in many scattered areas in the five municipalities and would not interest international bidders. The replacement and upgrading works and extensions to the distribution system at Jinhae, estimated at $2.2 million are also unlikely to interest international bidders because of their relatively small size, the nature of water treatment plant upgrading works and the remoteness of Jinhae. The total value of these minor civil works is about $10.0 million (foreign exchange component of about 45%) and represents about 4% of the project cost. These works would be advertised locally and

Table 4.2: FORECASTS OF DETAILED DESIGN COMPLETION AND BID DATES

Detailed Engineering Completion Dates	
Dongbok Dam	December 31, 1981
Water treatment plants	February 28, 1982
Bid Dates	
Pipe procurement:	January 22, 1981
Pipe installation:	
Daegu and Masan	December 16, 1981
Gwangju	December 31, 1981
River intakes, Daegu and Masan	December 31, 1981

Table 4.3: FINANCING PLAN FOR THE PROJECT /a

	US$ (million)	Won (billion)	%
Requirements			
Part A plus other works /a	381.7	251.92	99.0
Part B			
MOC	4.0	2.64	1.0
Total Requirements	385.7	254.56	100.0
Sources			
Water Bureaus net internal generation	84.3	55.64	21.9
Consumer contributions	26.7	17.62	6.9
Equity contributions	6.5	4.29	1.7
IBRD loan:			
Water Bureaus	86.5	57.09	22.4
MOC	3.5	2.31	0.9
Total IBRD loan	90.0	59.40	23.3
Water bureaus' local borrowings /a	177.7	117.28	46.1
Government contributions (MOC)	0.5	0.33	0.1
Total Sources	385.7	254.56	100.0

/a For details see Table 5.1.

interested foreign bidders would have opportunities to participate. In respect of the leakage reduction program and service connections totalling about $9.5 million the municipalities would use their regular staff and/or local plumbing contractors. The cities would submit to the Bank statements of expenditure, covering these works, according to procedures acceptable to the Bank. Supporting documents will be retained by each city with copies in MOC and made available to Bank missions if required. The statements of expenditure will be audited according to procedures acceptable to the Bank.

4.10 Specialized Equipment. Leakage control equipment estimated at about $1.0 million would be procured through limited international tendering. This equipment is highly specialized with a limited number of suppliers and deliveries are required to be carefully coordinated with staff training, which would be difficult to achieve through normal ICB.

4.11 Disbursement. Disbursements for civil works would be 40% of the expenditures. For equipment and materials, disbursements would be 100% of the foreign exchange cost of directly imported equipment, 100% of the ex-factory price of locally manufactured equipment; and 65% of goods procured locally (off the shelf items), with a ceiling of $500,000 for such purchases. For costs of consultants and training, disbursements would be 100% of expenditures. The estimated schedule of disbursements is presented in Annex 5. Because these are heavy infrastructure type of works and since detailed design will be substantially completed by the time of loan approval the disbursement profile is an improvement on the country wide disbursement profile for Korea. The closing date for the proposed Bank loan is June 30, 1986.

Project Implementation

4.12 MOC. MOC's Water Resources Bureau will employ consultants to carry out master plans and feasibility studies, detailed designs and tendering services for the preparation of future water supply projects in both urban and rural areas, carry out a manpower survey and train staff in the sector. The tentative list of areas that will benefit include a regional water supply system based on the dam at Daechong, Samjin Basin, Nam River Basin, Daechun region and extensions to cities on the outskirts of the Seoul Metropolitan area. MOC would consult with other concerned ministries such as MHA and MOHSA in deciding upon priorities. MOC would also coordinate implementation of the project (see para. 2.02).

4.13 Masan Region. The director of the Masan City Water Bureau will head a Project Office to be established in the Bureau to build the municipal bulk water supply system serving Masan, Changwon and Jinhae. The Project Office is expected to be created by February 1, 1982 and the terms of the agreement between the three municipalities of Masan, Changwon and Jinhae should be acceptable to MOC, EPB and the Bank (see para. 2.05). The execution of the agreement would be a condition of effectiveness of the proposed loan. The satisfactory staffing of the Project Office would be a condition of disbursement of the portion of the loan to the Masan Region.

4.14 Gwangju. Gwangju has prepared a resettlement program for the 880 families now living in the area to be inundated by Dongbok reservoir. This was discussed during negotiations. The finalization of the program will be a condition of disbursement of the Gwangju portion of the proposed loan. Gwangju is also making arrangements with the Industrial Sites and Water Resource Development Corporation (ISWACO) for assistance with technical supervision of the design and construction management of the 43 m high Dongbok dam, formulating operating rules for the reservoir, and procedures for the maintenance of the dam, acceptable to the Bank. The dam and appurtenant works including tunnels will be designed by a Canadian consulting firm (Shawinigan) in a joint venture arrangement with SAEL/KECC the consultants who prepared the feasibility studies. Gwangju would also appoint a Special Board of Consultants (SBC) comprising an engineering geologist an expert on dam design and a dam and tunnel construction specialist to advise upon any special technical problems concerning the safety of the dam encountered in the design and construction of the project. A hydrologist and other specialists would be employed for short periods, as required by the Bank. It was agreed during negotiations that as a condition of disbursement Gwangju would have appointed ISWACO and SBC. The qualifications of the members and terms of reference of the SBC should be acceptable to the Bank.

4.15 Daegu. Daegu was the first city to appoint consultants for detailed design. The present Director of the Water Bureau is competent and no special problems are expected. Work on detailed engineering and preparation of bid documents is proceeding satisfactorily.

4.16 Consultant Services. The consultant services for the preparation of detailed designs and supervision of construction for the five cities are based upon 5% of the base line construction costs; this is reasonable. Though there are local Korea consulting companies it is not anticipated that they would play the lead role and for the purpose of the cost estimates it is assumed that internationally recruited consultants would be employed in joint ventura arrangements with local consultants. The MOC studies for future water supply projects are expected to have foreign inputs in areas where local consultants have to acquire adequate expertise. The average man-month cost for internationally recruited consultants including housing, transportation and local costs in 1981 is expected to vary between $9,000 and $11,000 depending on qualifications, experience and country of origin. Local counterpart staff average $1,200 per man-month. There are three local consulting firms which may be expected to participate and by the time of project completion would through the joint-venture arrangements with foreign

firms or by direct hire of foreign experts in areas which require strengthening, develop sufficient capability to be able to carry out future engineering with minimum assistance from foreign consultants. This approach has been sufficiently demonstrated in the preparation of the feasibility studies (see para. 4.02).

4.17 For Masan Region, Daegu and Gwangju, internationally recruited consultant man-months are estimated to be 106, 109 and 154 respectively; local counterpart man-months will be approximately double.

4.18 Based upon the experience with the preparation of this first project MOC, with the available financing, would be in a position to prepare about 10 major projects in water supply to the stage of completing tender documents and bid evaluation which would require about 25 internationally recruited man-months representing 10% of the total estimated consulting time.

4.19 It was agreed during negotiations that the five cities and MOC would employ consultants for detailed design and supervision of construction whose experience, qualifications and terms of reference will be acceptable to the Bank. The five cities also gave assurances during negotiations that all land acquisition for the project, which has already commenced, would be completed by June 30, 1983 except for Gwangju where it would be completed by June 30, 1984. The project is expected to be completed by December 31, 1985.

5. FINANCIAL ANALYSIS

Past and Present Financial Performance

5.01 Water supply expansion programs in Masan, Gwangju and Jinhae have been carried out in a piece-meal fashion and have not required the mobilization of large financial resources. Daegu has however satisfactorily undertaken large projects financed by USAID and ADB. Changwon is a new industrial town inadequately serviced by MOC's Majin system with very little investment in water supply systems of its own. It has been Government policy not to make any grants for development of water supply systems to large and medium-sized cities. Consequently, expansion is normally financed from internally generated funds, bonds issued by the municipalities, city funds, MOC approved government loans and rarely, foreign borrowing.

5.02 The following table prepared on the basis of projected financial statements summarizes the estimated financial highlights of the five water bureaus at the end of 1980.

	Gwangju	Daegu	Masan	Changwon	Jinhae
% Debt/(Debt plus equity)	10	7	13	-	15
Current ratio	1.9	1.5	6.1	1.1	2.0
Working capital (million won)	457.7	968.4	288.9	12.0	49.3
Rate of return on revalued assets	1.1	(1.5)	(10.4)	3.5	2.7
Operating ratio (%)/a	73.4	82.4	126.6	78.0	51.9
Water rate (won/cu m)	103.0	83.7	98.5	63.7	70.0
Debt service coverage	3.6	3.4	1.9	-	4.4

/a Excluding depreciation.

5.03 These highlights show that Gwangju, Changwon and Jinhae present a satisfactory financial position. Daegu has a negative rate of return in 1980 when depreciation on adjusted revalued fixed assets is charged; nevertheless, the bureau of this city will generate enough income before depreciation to maintain a healthy debt service coverage. In addition, it will have non-operating revenues mainly from connection fees - which will improve its liquidity position. Masan's position is not satisfactory in 1980 due to lower revenues and higher expenditures than those anticipated at the time of appraisal. However the municipality has recognized this position by imposing the largest average tariff increase of all the cities in 1981 and the financial situation is expected to show progressive improvement.

Tariffs

5.04 Tariffs are customarily reviewed every one or two years, municipalities presenting their requests for tariff increase to the MHA through the provincial government. The tariff structures are progressive, penalizing wasteful use of water. The five cities made tariff increases in April 1981 so that the average tariff in 1981 will increase over 1980 by the following percentages Gwangju 21%, Daegu 21%, Masan 62%, Changwon 61%, Jinhae 34% and are undertaking a further tariff review with a view to implementation not later than March 1, 1982. Implementation of the tariff increases proposed for 1982 was discussed during negotiations. The cities would use their best efforts to implement these increases by the due date.

Financing Plan

5.05 Table 5.1 summarizes the financing plans for each one of the five water bureaus in the project. The proposed financing plan is satisfactory and

Table 5.1: WATER BUREAU FINANCING PLANS, 1982-85
(US$ million)

Requirements	Gwangju		Daegu		Masan		Changwon		Jinhae		Total	
	$	%	$	%	$	%	$	%	$	%	$	%
Investment in project	101.7	77.1	73.4	47.9	36.2	56.1	18.6	70.9	4.4	72.5	234.3	61.4
Other works	3.1	2.4	60.9	39.8	19.3	30.0	3.5	13.9	0.7	11.2	87.5	22.9
Interest during construction	27.0	20.5	18.9	12.3	9.0	13.9	4.0	15.2	1.0	16.4	59.9	15.7
Total Investment	131.8	100.0	153.2	100.0	64.5	100.0	26.1	100.0	6.1	100.0	381.7	100.0
Gross internal generation	42.5	32.2	48.8	31.9	21.1	32.7	5.4	20.7	3.2	53.5	121.0	31.7
Minus: Debt service	13.7	10.4	10.4	6.8	3.9	6.1	2.0	7.5	0.7	12.2	30.7	8.0
Working capital/others	1.6	1.2	4.2	2.8	-0.3	-0.6	0.1	0.5	0.4	7.0	6.0	1.6
Net Internal Generation	27.2	20.6	34.2	22.3	17.5	27.2	3.3	12.7	2.1	34.3	84.3	22.5
Consumer contributions	0.0	0.0	21.1	13.8	3.7	5.6	1.5	5.9	0.4	6.7	26.7	7.0
Equity contributions	0.0	0.0	0.0	0.0	0.0	0.0	6.5	24.8	0.0	0.0	6.5	1.7
IBRD loan	36.3	27.1	27.1	17.8	13.9	21.6	7.4	28.4	1.7	28.7	86.4	22.6
City bonds	22.4	17.0	14.5	9.4	7.1	11.0	0.0	0.0	0.5	8.2	44.5	11.7
Government loans	46.0	34.9	23.4	15.2	11.2	17.3	5.6	21.4	1.3	22.1	87.5	22.9
Loans for other works	0.0	0.0	32.9	21.5	11.1	17.3	1.8	6.8	0.0	0.0	45.8	12.0
Total Loans	104.6	79.4	97.9	63.9	43.3	67.2	14.8	56.6	3.6	59.0	264.2	69.2

it assumes that: (a) tariffs were increased by up to 60% in April 1981 (see Annex 7) with further increases in subsequent years; (b) that the Bank loan will be onlent to the municipalities to finance the foreign components of their projects on the same terms as the Bank loan to the Government plus a service charge of 0.05% per annum; (c) that according to Government decision 70% of the local component for Gwangju and 50% /1 for other cities will be financed from government loans at 13% interest p.a. and 20 years repayment period including 5 years grace period; (d) that city bonds will carry 8% interest p.a. with total payment of interest and principal at the end of five years. Changwon is planning to use municipal funds instead of bonds to help finance its project. Assurances by the cities with respect to these financial arrangements were obtained at negotiations.

5.06 The terms assumed for Government loans and city bonds are those presently used in Korea to finance this kind of investment. City bonds are bought by contractors and other users of municipal services. Agreement was reached during negotiations that the Government would make the loans required by the cities for the project.

Future Financial Performance

5.07 Financial projections for each one of the five cities are presented in Annex 6 and the underlying assumptions in Annex 7. Projections were prepared with the objective of attaining a long-term sound financial position for each water bureau, based on a sustainable balance between equity and debt, minimizing financial cost to the cities. During the project construction period estimated revenues from water sales are those required to cover the resultant financing gap after the loans from IBRD, Government, city bonds and, in the case of Changwon the municipal equity contributions. Although the resultant average tariffs reflect substantial increases in the early years, they are considered realistic given their present low level, the users' capacity to pay and the municipal and central government's willingness to bring their water rates to levels more in line with the financial needs of the systems.

5.08 It was estimated that after project completion, the tariffs would cover operation and maintenance, depreciation or debt service, whichever is higher and contribute to future expansion requirements. Additionally, a target was set to maintain the debt service coverage ratio above 1.3. This ratio is adequate for these projects since the debt service will be high in the 3 or 4 years following project completion due to the repayment of city bonds but will then drop considerably. For this reason a higher ratio would require unnecessarily high tariffs. Appropriate covenants have been incorporated in the legal documents of the proposed loan to ensure that the cities achieve the above objectives and maintain the financial soundness of the water systems (see paras. 5.10, 5.11 and 5.14).

5.09 Table 5.2 presents a summary of the project financial position of the five cities during the period 1982-88. Based on the underlying assumptions their performance is expected to be satisfactory.

/1 Excluding consultants fees, local improvements and taxes.

Table 5.2: SUMMARY OF FUTURE FINANCIAL PERFORMANCE

	1981	1982	1983	1984	1985	1986	1987	1988
1. Debt as a % of Debt Plus Equity								
Gwangju	7	54	63	62	55	46	37	34
Daegu	9	17	25	30	30	22	14	11
Masan	11	46	58	55	52	47	37	31
Changwon	2	49	53	54	43	40	36	31
Jinhae	12	29	36	32	26	20	15	11
2. Debt Service Ratio								
Gwangju	6.0	9.7	14.0	3.0	2.1	2.5	1.3	1.2
Daegu	2.0	9.6	16.1	4.8	3.1	4.5	1.3	1.3
Masan	8.7	18.9	26.8	12.0	2.2	2.6	1.6	1.4
Changwon	-	-	-	3.7	1.6	1.8	1.2	1.4
Jinhae	5.0	7.5	9.8	5.3	2.5	4.0	2.5	2.5
3. Rate of Return /a								
Gwangju	7.1	10.6	11.2	11.9	9.1	10.0	10.0	10.0
Daegu	(2.1)	0.3	2.7	5.2	4.7	8.0	8.0	8.0
Masan	0.6	7.5	16.1	15.4	8.5	8.0	8.0	8.0
Changwon	12.6	15.4	15.0	6.8	6.4	7.0	7.0	7.0
Jinhae	5.3	10.6	10.2	8.0	8.0	8.0	8.0	8.0
4. Operating Ratio % /b								
Gwangju	55	53	48	31	28	24	25	25
Daegu	85	73	65	61	61	46	44	44
Masan	74	60	51	35	35	34	34	34
Changwon	54	41	37	42	40	41	42	43
Jinhae	47	38	37	36	36	34	35	36

/a On net revalued fixed assets. Covenant effective from 1986.

/b Excluding depreciation.

Revaluation of Assets

5.10 By law the Water Supply Bureaus are required to revalue their fixed assets every five years. These revaluations are incorporated in the Bureaus' accounts. The proposed revenue covenants (para. 5.14) would require that the Bureaus' fixed assets should be revalued every year using the GNP deflator published by the EPB or other index acceptable to the Bank.

Debt Control

5.11 To help protect the financial position of the Water Supply Bureaus of the five cities, agreement was reached during negotiations that the cities on behalf of their Water Supply Bureaus (Gwangju, Daegu and Masan) and the Water Supply Sections (Changwon and Jinhae) will not, without the Bank's approval, incur any long-term debt in any year, unless a reasonable forecast of the net revenues for each year, during the term of the debt to be incurred, is not less than 1.3 times its projected debt service requirements for each such year, on all such debt including the debt to be incurred.

Duties and Taxes

5.12 The Water Supply Bureaus (and Sections) do not pay income taxes but they pay custom duties ranging from 10% to 15%.

Insurance

5.13 The cities in the project carry limited insurance or no insurance at all as in Gwangju. During negotiations, agreement was reached that the municipalities should have their Water Supply Bureaus covered against the normal risks related to their operations.

Revenue Covenants

5.14 Agreement was obtained during negotiations that the five cities will undertake on behalf of their Water Supply Bureaus and Water Supply Sections an immediate review of their financial position to establish the level of tariffs to meet their cash flow requirements in 1982 and implement such findings by March 1, 1982 and thereafter take the following actions:

(a) each year, starting in 1982, review their financial position and update their financial projections for the following five years;

(b) as a result of said review, they will establish the level of tariffs needed to meet their cash flow requirements for the following year and to achieve (i) self-financing ratios during the period 1982-85 of at least 20%; and (ii) after 1985 obtain the following rates of return on revalued fixed assets in operation: 7% for Changwon, 8% for Daegu, Masan and Jinhae and 10% for Gwangju;

(c) furnish such reviews to the Bank for its comments not later than October 1 of the year preceding the projection period; and

(d) taking into account the comments of the Bank, implement the findings of such review by March 1 of the following year.

Monitoring Indicators and Reports

5.15 Monitoring indicators for each city are presented in Annex 6. During negotiations these indicators were discussed with the five cities and MOC. The content and frequency of the reports required to monitor their operations and the implementations of their respective projects were also discussed.

6. JUSTIFICATION

General

6.01 Because of the rapid urbanization, municipal water supplies in Korea are becoming more scarce and expensive to develop. These problems, however, cannot be successfully tackled without some institutional reforms. The proposed project, while meeting the urgent water supply needs of the five cities, and raising living standards of the low income population would support the Government's efforts to make a start on reorganizing the sector and also to prepare future high priority water supply projects. The project would put special emphasis on the application of sound financial and management policies in the five cities and also increase the efficiency of the allocation and use of water resources in the country, beginning with the Masan Region.

Least Cost Solution

6.02 Planning and design criteria suited to local conditions were selected for developing alternative solutions for major project components such as the siting of river intakes and transmission systems for Masan and Daegu and for the selection of the dam site and raw water transmission system for Gwangju. Cost curves were developed based upon local information, MOC's standard cost tables and experience elsewhere. For some major components such as the Dongbok dam the curves were checked against recent bids received by MOC for similar works. Economic lives were assigned to pumping stations (30 years), pipelines (50 years) and dams (100 years). As a first step technically feasible alternatives were developed and compared using discount rates of 10% and 12%. Of these the best three were subjected to rigorous financial and economic analysis to determine affordability and tariff structures.

6.03 The economic analyses for Daegu and Masan to select the least cost solution, were straight forward because the source selection variables were limited to two locations, in each case, for river-intakes and treatment plant sites. The analysis for Gwangju, however, was complicated by staging needed to supply long-term needs (year 2010) from two dam sites - Dongbok and Juam to a new treatment plant site near Gwangju at Seongdong. Eleven alternatives

were identified, of which six were selected for present worth analysis at a discount rate of 12% of both capital and operating costs. (See Chart 22347). All but one of the discounted costs were close to each other and of these the alternative judged to be most practical and having least construction risks under the present circumstances was selected for the project.

6.04 Three types of dams, zoned earthfilled, earthfilled dam with rock shell and rockfill dam with concrete face, have been identified as being suitable for the Dongbok site. Rockfill material is readily available at the site; sandy silty clay which will require some mixing with coarser material to increase the strength characteristics of the clay sufficiently to make it acceptable as an impervious core material, is available about 12 km from the site; and sand suitable for filter material (or concrete aggregate) is available 23 km from the site. The preliminary engineering estimates were based on a rockfill dam with concrete or asphalt face as being the least cost dam type. A final study on the type of dam made during the design phase following a more detailed investigation of the availability of material has confirmed the earlier selection.

Service to the Poor

6.05 There is little reliable data on the urban poor, and the following represents best estimates only, based on limited studies. An estimated 18% of the urban population can be categorized as being below the absolute poverty income level./1 The population served in the five cities on project completion would be 3.5 million, about 90% of their total population. Using the 18% estimate of the population in the absolute poverty category, the poor population benefitting would be 630,000. Since the poor do not live in well defined pockets and are scattered in areas which are also partly commercial and middle income residential, no precise estimate is possible of what proportion of the total project cost can be attributed to meeting the needs of the group.

Affordability

6.06 Assuming a poor family of 6 persons consuming 77 lcd (as found in the 1979 Daegu Survey) the monthly household water consumption would be 14.0 cu m and the family would be charged W 500 - the minimum block rate for 15 cu m in effect at that time. Using the exchange rate of W 484 prevalent in 1979 - this represents 1.0% of the monthly income of $93 of a poor family at the lower end of the scale (see para. 3.06). Assuming that incomes of poor families increase at the same rate as inflation and the minimum block rate increases at the same rate as average tariffs, the poor family in 1985 would be charged about 1.7% of family income. This is not a high charge and in part explains the anticipated reduction in the number of standpipes in the cities. The number of public/private standpipes (360 in Daegu, 23 in Gwangju and 200 in Masan Region) are expected to be phased out by about 1990. The

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/1 As defined by the Bank.

present charge for lifeline amounts (10 cu m/month) in Daegu is W 50 and if purchased from vendors, about W 70 per cu m. This is a typical situation. After project completion in 1986 the tariffs are likely to have increased in the individual cities by between 30% and 80% in real terms over 1981. This is reasonable in relation to the greatly improved service to be provided and is affordable. This was discussed during negotiations and the cities understood the implications of the financial covenants related to increases of tariffs required to meet the 20% self-financing ratio and rate of return requirements.

Incremental Rates of Return

6.07 The incremental rate of return (IRR) for each one of the five projects was calculated in border prices using revenues from consumer charges as a proxy for the economic benefit of the project. Details are at Annex 8. Tariff increases were projected for all cities. Assuming that the consumers will be willing to pay those tariffs, the IRR for the five projects are adequate considering that they represent the minimum benefits expected. The following table shows the IRR for each bureau and their sensitivities to increases in costs and reductions in benefits:

		Sensitivity			
	IRR	20% Increase in investment cost	20% Increase in O & M	10% Reduction in benefits	10% increased investment and 10% decrease in benefits
Daegu	16.1	13.9	14.0	13.7	12.7
Gwangju	11.6	9.8	11.5	10.4	9.6
Masan	13.2	11.0	13.0	11.9	10.8
Changwon	11.7	9.9	10.6	9.5	8.6
Jinhae	10.3	8.8	9.2	8.9	8.2

Long Run Marginal Cost and Tariffs

6.08 The average incremental cost (AIC) method was used to compute the long-run marginal cost. The following table presents the AIC for different discount rates, compared to the average water rate for each project. It shows that the tariffs expected to be implemented are not too far from the AIC except for the comparatively less economically developed Jinhae and Changwon.

	Discount rates		Average water tariff /a
	10%	12%	
	(won/cu m)		
Daegu	156	172	187
Gwangju	203	245	190
Masan	198	234	180
Changwon	194	213	140
Jinhae	164	191	115

/a Tariff at the end of project completion deflated to 1981 prices.

Employment

6.09 The project construction is expected to generate demand totalling 420,000 man-days of skilled, 840,000 man-days of semiskilled and 2,000,000 man-days of unskilled labor. In addition employment in the city's water supply systems is expected to increase - Masan region 50; Gwangju 60 and Daegu 80.

Environmental Impact

6.10 Daegu and Masan are making plans to build wastewater treatment facilities, while Changwon has a new sewage treatment plant. In Jinhae waste water from domestic sources and industry pose a serious problem to the bay and the city has plans for a future wastewater treatment plant. By project completion time all of the cities could start implementing programs for improving the environment and dealing with the additional waste water generated by the project. All the cities have surface water drainage systems in most areas and no unusual drainage problems are anticipated as a result of the project.

Project Risks

6.11 Except for Daegu, this is the first major water supply expansion being undertaken by the Water Supply Bureaus of Masan and Gwangju. This is also the first time that MOC has been involved in a major Bank project in the sector. There is, however, adequate provision in the project for engineering consultants to advise on project preparation and in designing and supervision of construction of all the major components. There is also an adequate number of skilled contractors in Korea who can construct the project. No unusual risks are therefore anticipated with the implementation program.

6.12 With regard to the institutional changes, the Government recognizes their need and with Bank supervision missions giving this aspect special attention, no unusual problems are anticipated.

7. RECOMMENDATIONS

7.01 During negotiations agreement was reached with Government and the five cities on the following main points:

(a) that the Government would:

(i) upgrade the organization of the sector (para. 1.06);

(ii) study pollution in the Nakdong River Basin (para. 1.10);

(iii) carry out a manpower survey (para. 1.15);

(iv) review future water supply investments in the Masan region (para. 2.06); and

(v) make satisfactory financing arrangements (paras. 5.05 and 5.06).

(b) that the five cities would, respectively:

(i) not transfer funds generated for water supply, introduce accrual based accounting and appoint independent auditors (para. 2.11);

(ii) Daegu, Gwangju and Masan implement leakage surveys (para. 3.07);

(iii) complete all land acquisition by June 30, 1984 (4.19);

(iv) employ consultants for supervision of construction (4.19);

(v) not exceed the 1.3 debt service coverage; (5.11);

(vi) take insurance against normal risks; (5.13); and

(vii) review annually their financial positions and adjust tariffs to achieve the revenue covenants (para. 5.14).

7.02 Conditions of effectiveness of the proposed loan would be the strengthening and staffing of MOC's Water Supply Bureau (para. 2.02) and the signature of the Regional Management Agreement between the cities of Masan, Changwan and Jinhae (4.13).

7.03 Conditions of disbursement of the portions of the loan to be made to the individual cities would be:

(a) signing of subsidiary loan agreements (para. 2.01);

(b) staffing of the Masan Project office (para. 4.13);

(c) preparation by Gwangju of resettlement program (para. 4.14);

(d) Gwangju appointing ISWACO and an SBC (para. 4.14).

7.04 The proposed project is suitable for a Bank loan of $90 million for a term of 15 years including a grace period of 3 years.

KOREA

FIRST WATER SUPPLY PROJECT

Gwangju City

New Dongbok Dam

Background

1. Gwangju City employed Chas. T. Main in a joint venture with Korean Engineering Consultants Ltd. to prepare the feasibility studies for the selection of the source. The preliminary engineering studies which proposed the New Dongbok Dam were reviewed by Mr. Ralph Bloor, Bank consultant and on his advice additional drillings were carried out at the Dongbok site. The results of the drilling were discussed by Mr. Bloor with Chas. T. Main geologist and decided as being adequate for preparing an estimate with a physical contingency provision of 15%. Following a change in consultants, the studies were completed in August 1980 by Stanley Associates Engineering Ltd. in association with Chas. T. Main and Korean Engineering Consulting Corporation. Two members of the Special Board of Consultants (SBC), a geologist and dam specialist, visited the site, reviewed the reports and made comments on the Terms of Reference for the detailed design. The SBC also reviewed the Terms of Reference of the Industrial Sites and Water Resources Corporation (ISWACO) selected by Gwangju City for construction management servcies.

Source Selection

2. Least-Cost Solution. The Dongbok dam site was selected as the least-cost solution for source development for the first stage after a review of all feasible alternative sources including groundwater availability. The Juam dam site was selected as the source for the second stage, up to year 2010.

Water Resources

3. Groundwater Resources. Groundwater is used extensively from some 12,000 shallow private wells (10 m to 30 m) and 500 public and irrigation wells. Drilled wells up to 80 m in depth of diameters ranging from 150 mm to 200 mm have widely varying yields - averaging 450 cu m/d in 30 wells, for which data is available. Water in the shallow wells is generally polluted. The aquifer is mostly alluvium - about 7 m in thickness - and bedrock formations of andesite and granite around the city. The weathering zone of the bedrock varies from 1 m to 23 m and under certain conditions yields 500-700

cu m/d. There are five basins in the area suitable for groundwater development, however, natural recharge has been reduced because of lower base flows in the rivers following the construction of irrigation dams, making groundwater unreliable for long-term development as a municipal water supply source. Groundwater is, however, being developed for agricultural and industrial use.

4. Surface Water Resources. Surface water has been developed for large irrigation - Dam Yang, Jang Seon and Seong Dong reservoirs managed by the Agricultural Development Corporation (ADC). All these reservoirs control tributaries flowing into the Yeong San River. None of them have extra capacity to provide municipal water supplies. Neighboring basins are: Boseong River, Seon Jin River and Tam Jin River. Potential reservoir sites in these basins were screened for yield and dam design feasibility. Precipitation studies were based on correlations of the annual rainfall records of 25 stations in the region with that of Gwangju the longest (64 years) and most reliable of all. Hydrometric records or discharge measurements are virtually nonexistent for the purposes of establishing rainfall-runoff relationships or estimating yields. The consultants therefore used the "Japanese Formula," an empirical relationship widely used in Korea to calculate runoff. Due to lack of hydrologic data synthetic runoff and flood hydrographs determined spillway designs and diversion requirements. Reservoir capacity investigations and flood studies were made for each selected dam site followed by a review of the available geological information. The Yeong San River is tidal for a distance of 60 km from its mouth near Mogpo. An estuary dam to prevent tidal inflow is expected to be completed in 1981. The estuary reservoir is therefore a potential source for Gwangju but would require a 70 km transmission pipeline with a static lift of about 100 m and several pump stations.

5. The preliminary screening eliminated the estuary reservoir as an immediate source for Gwangju because it was not only the most costly but also was the lowest in water quality due to uncontrolled industrial and organic pollution of the Yeong San River. Out of four possible dam sites - Dongbok on the Dongbok tributary of the Boseong River, Dong Gae on the Dong Gae tributary of the Seom-Jin River, Jam Heung on the Tam Jin River and Juam on the Boseong River - two sites, Dongbok and Juam, were selected to be the least-cost sources for closer study. Six alternatives were tested and the new Dongbok dam selected as the first stage project (see Alternative 1, Chart 22347).

Dongbok Dam - Main Features

6. Based on the hydrological analysis the following capacities and preliminary design parameters were established for a yield of 250,000 cu m/d recognizing that changes would be made during detailed design:

Active storage	68,000,000 cu m
Evaporation depletion	17,000,000 cu m
Dead storage	7,500,000 cu m
Total storage	92,500,000 cu m
Minimum operation level elevation	144.0 m
Spillway crest elevation	162.2 m
Minimum water level elevation	176.7 m
Freeboard	3.5 m

7. Preliminary details of the new dam are as follows:

Dam type	Rockfill dam with concrete face
height	43 m
length	180 m
Diversion Tunnel	
Diameter	5.5 m
Length	220 m

Dam Site Geology

8. Information available from (i) the construction of the existing mass concrete Dongbok Dam, (ii) the geological survey report on a proposal (now abandoned in favor of the Juam site) to build a dam 100 m downstream of the existing dam, and (iii) additional investigatory drilling made by the consultants provided the basis for their conclusions that with adequate treatment of the foundation the site was suitable for a rockfill dam with concrete face. This concluision was generally confirmed by Bank consultant Mr. Bloor and subsequently by the two members of the SBC (para. 1.0).

Detailed Design

9. The following are summary extracts from the scope of services in the Terms of Reference for the detailed design of the Dongbok Dam:

(a) Dam Site: subsurface evaluation, evaluation on field survey, hydrologic and hydraulic analysis, design of dam structure, spillway including model tests. Specially, define a detailed program of geological explorations for the above and the technical direction of those explorations.

(b) Intake Site: evaluation on field survey, design of intake structure, diversion tunnel, pumping station layout, piping and electrical works.

(c) Reports:

(i) report on hydrological study and definition of design floods, preliminary design criteria discussing alternative dam types and arrangements of works and recommending a particular scheme of development including river diversion shall be described in the preliminary design report for the dam including sedimentation data and life of the reservoir. This report should be accompanied by the detailed geological exploration program for the structure, quarry sites, and borrow areas;

(ii) comprehensive report on the geological explorations including Seismological data and basis for establishing earthquake design criteria; and

(iii) prepare and submit the Design Reports incorporating the above services to the city for the Bank's review. The Design Reports shall include all final criteria and design calculations and form technical specifications of a clear basis for the prepration of tender documents.

10. The consultants for detailed design, Stanley Associates Engineering, Ltd., in association with Shuanigan and KECC have reviewed the preliminary cost estimates based upon detailed surveys and geotechnical investigation which are progressing satisfactorily. A review of the detailed design work by the SBC is scheduled for early September 1981. The final design report is due before November 30, 1981.

KOREA

FIRST WATER SUPPLY PROJECT

Water Supplies in the Project Cities

General

1. Water demand is about the same with a little variation because of differing economic situations and state of facility development in each of the five cities. Daegu is the fastest growing city, where despite recent works to improve supply parts of the suburbs suffer shortages. All the other cities experience severe water shortages - especially Gwangju in which there has been no major facility development since 1973 when consumption exceeded system capacity.

Water Resources

2. Water resources unless carefully conserved would soon become increasingly unreliable towards the end of the century in all of the five cities. Groundwater is available in small quantities in Gwangju and Changwon and is presently exploited by industry. It is also endangered by industry in Changwon because of the uncontrolled discharge of industrial wastes into adjacent water courses which recharge the aquifers. Jinhae supplements its municipal water supply with 3 wells yielding small quantities of about 2,000 cu m per day.

3. Gwangju presently obtains its water from an upland catchment at Dongbok about 18 km from the city. In the future it will have to go another 10 km to Juam for water. The other cities obtain their water from the Nakdong River. Not only is this river becoming more and more polluted by industry but also competing demands for water unless controlled could decrease abstraction in the future. All of the cities are affected by the cyclical droughts every five or six years when water has to be rationed. The government is alert to the situation and is taking action through a program of water resources development and implementation of the Environmental Preservation Law.

4. Nagdong River. The Nagdong River is 520 km long and has a drainage basin of 23,656 sq km that covers almost one quarter of the country (see Map IBRD 15431). Following an UNDP/FAO study in the late 1960s, the Government has constructed and now operates the Andong multipurpose reservoir (storage $1,000 \times 10^6$ cu m) which regulates the flow of the main stem of the Nakdong River from near its source, down to the sea at Busan. On the main stem, there are substantial abstractions and returns of water, which are used for municipal, industrial, and agricultural (irrigation) purposes. The UNDP study and later studies showed that the Andong reservoir would meet demands on the main stem to the mid-1980s, provided droughts no more severe than the 1967/68 drought, judged to be the 1 in 10 year event occured. However, with increasing development and use of the water resources of the basin, this design drought criterion needs to be reviewed since the 1 in 10 year event is too low a standard for large industry and municipal needs. Major resource

development works are usually designed and operated to withstand droughts of 1 in 20 year to 1 in 100 year frequency. The lower frequency relates to works whose failure would have the greater adverse social and economic impact, as it would in Daegu, Masan, Changwon and Busan.

5. In parallel with proper development and management of the Basin's water resources quantitatively is the protection of water quality. To date, little attention or capital investment has been directed towards the prevention of pollution of the Nakdong River. The predictions of river water quality in the 1980s and 1990s are ominous, unless major wastewater treatment facilities are installed. In respect of Daegu and the Masan region, serious water treament problems for their municipal supplies will arise, unless the quality of the Nakdong River is safeguarded. These problems are almost exclusively from the discharge of untreated waste water from Gumi and especially Daegu. Also the proposed installation of a barrage at the mouth of the river below Busan to prevent saltwater intrusion could compound pollution problems in the lower reaches. In order to ensure that the water supplies for Daegu and the Masan Region are adequate, both in terms of quantity and quality, the project provides for the preparation of an environmental management plan with an optimum development strategy for the day-to-day operation and management of the basin's resources both for water quantity and water quality.

6. Dongbok Reservoir. An average of 60,000 cu m per day is pumped to Gwangju City from the Dongbok reservoir, formed by a 18 m high mass concrete dam, through a 800 mm diameter 28.5 km long raw water pipeline. The reservoir has a catchment area of 189 sq km and a storage volume of 7.06 million cu m. Except for seasonal problems caused by algal growths which make water treatment difficult, water quality is good. Detailed flow data for the Dongbok reservoir are not available and the consultants used an empirical Japanese Formula for projecting yield of the Dongbok catchment area./1 It is estimated that the safe yield of the catchment is 250,000 cu m per day. The raw water would be conveyed through an 18.8 km pipeline to a new treatment plant near Gwangju. (Alternative 1, Chart - 22347). The feasiblity of this proposal was tested against five other alternatives and selected as the least cost solution for the first stage of a long term master plan to meet Gwangju's water supply needs. (See Annex 1 for description of the Dongbok Dam).

Existing Water Supply Systems

7. Daegu. All five cities have water supply systems. The biggest is in Daegu, which in addition to abstracting 240,000 cu m per day from the

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/1 Chas. T. Main and the Korean Engineering Consulting Coporation made the original calculations. Stanley Associates Engineering reviewed the projection.

Nagdong River, has three other local sources of varying quality and reliability yielding another 110,000 cu m per day. This is reputedly the best water utility in the country. The water is treated in four conventional water treatment plants the largest of which has a capacity of 220,000 cu m per day. The plants work generally well, there being few operational problems. The water is distributed through some 70 km of pipe of diameter ranging from 1,200 mm to 150 mm at pressures varying between 2.0 to 5.0 kg/sq cm. Distribution storage volume in 35,060 cu m and there are several booster stations. Chlorine residuals at these points vary between 0.3 and 1.0 ppm. There were 131,445 service connections in 1978 of which 98% were below 25 mm. All services are metered and unaccounted for water was reported to be a high 36% in that year. This is reputedly the best water utility in the country.

8. Masan Region. Masan, Changwon and Jinhae presently purchase their raw water from MOC's Majin Industrial Bulk Water Supply System. The Majin system was built in two stages in 1967 and 1976 and has a total capacity of 285,000 cu m per day. The source of supply is also the Nagdong River. The two stages are built in parallel and have similar components: river intakes, pumping stations, and about 18 km of raw water transmission pipelines. The 1976 system has a design capacity of 200,000 cu m per day and also a treatment plant with a capacity of 120,000 cu m per day and a treated water transmission pipeline to serve industry. The Majin system presently supplies 7,000 cu m per day of raw water to Jinhae, 42,000 cu m per day to Masan and 1,600 cu m per day of treated water to Changwon. An evaluation of the Majin system with a view to possible upgrading revealed serious problems of silting of the river intake and bottlenecks in the transmission system. The system, although presently operating at 70% of design capacity is expected to be fully used up in the next five years to meet industrial demand.

9. Masan's water treatment plant is badly designed, poorly operated and situated in a commercial downtown location. The plant will be closed down and the land sold when the proposed project is completed. Changwon is about to complete work in developing a small local source expected to yield 10,000 cu m per day to supplement the MOC supply until the proposed project is complete. Jinhae has in addition to the Majin supply another 6,000 cu m per day of raw water from local sources. The water is treated in a conventional treatment plant with a design capacity of 25,000 cu m per day. Some improvements such as providing treated water storage facilities and treatment quality control and maintenance are needed and are included in the proposed project. The treated water is distributed through some 71 km and 49 km of pipeline in Masan and Jinhae with diameters varying between 700 mm and 75 mm. Masan has 6,000 cu m of storage capacity, presently unused but could be put into service when adequate water is available. At present both cities suffer low pressures and in Masan water is distributed to six different areas at various time periods each day. Chlorination is intermittent and operational standards need considerable improvement.

Changwon has the beginnings of a distribution system. The three cities had 18,345, 9,141 and 505 service connections at end of 1978, all of which were metered.

10. Gwangju. In addition to the Dongbok reservoir, yielding 60,000 cu m per day there are three local sources of varying degrees of reliability bringing the average day supply to about 120,000 cu m per day. The water is treated in two conventional treatment plants, the larger of which is rated at 105,000 cu m per day. Both plants need repair, upgrading and improvement in operation and maintenance standards. There are some 157 km of distribution piping with diameters varying between 1,000 mm and 50 mm with 14,000 cu m of treated water storage at the treatment plant and 3,500 cu m in five booster pumping zones. Service is very poor with negative pressures frequently occurring in many parts of the system. Unaccounted for water is about 40% mostly from leakage. All service connections are metered and there were 50,132 service connections at mid-1979. Chlorination is inadequate and distribution service standards require improvement.

Metering

11. The calibration of production meters reported to be difficult problem in these cities. There is provision in the project for the training of staff and rehabilitation works which includes the training of instrumentation technicians. production metering. The maintenance of domestic meters is not a serious problem - the cities either sending defective meters back to the factory for repair or doing it themselves in meter repair workshop.

KOREA - FIRST WATER SUPPLY PROJECT

Project Description

Part A

Municipal Water Supplies:

Daegu

(a) construction of river intake and pump station structure for 814,000 cu m/d with pumps and equipment for 407,000 cu m/d;

(b) construction of raw water pipeline 1,800 mm diameter, 0.8 km for 407,000 cu m/d;

(c) construction of water treatment plant with a capacity of 370,000 cu m/d;

(d) construction of treated water pipeline 8.5 km and 1,800 mm diameter and 23.2 km of distribution pipelines 1,800-500 mm diameter;

(e) construction of three service reservoirs with a total storage of 35,000 cu m;

(f) construction of two new booster stations and upgrading of five existing stations.

(g) acquisition of leakage equipment including detectors and waste water meters;

(h) implementing leakage reduction program;

(i) constructing local improvements to distribution system;

(j) installing service connections;

(k) land acquisition and compensation; and

(l) consultant services for engineering and supervision of construction and staff training.

Gwangju

(a) Source development to increase water production from 100,000 cu m/d to 250,000 cu m/d including the construction of a rockfill dam 43 m high at Dongbok, diversion tunnel and spillway;

(b) tower intake and intake pumping station for 320,000 cu m/d;

(c) construction of 1,200 mm diameter, 13.0 km raw water transmission pipeline and 2.2 mm diameter lined tunnel 1.8 km;

(d) construction of water treatment plant with a capacity of 240,000 cu m/d;

(e) construction of 1,500 mm diameter 6.8 km treated water pipeline and 25 km of 900 mm to 400 mm diameter distribution pipeline;

(f) construction of two service reservoirs with a total storage of 25,000 cu m and booster station;

(g) acquisition of leak detection equipment, waste water meters, production meters and calibration equipment;

(h) implementing leakage reduction program;

(i) constructing local improvements to distribution system;

(j) installing service connections;

(k) land acquisition and compensation;

(l) consultant services for engineering and supervision of construction and training; and

(m) prepare and implement a resettlement program for Dongbok reservoir.

Masan Region

(a) construction of river intake and pump station structure for 400,000 cu m/d with pumps and equipment for 200,000 cu m/d;

(b) construction of raw water pipeline 1,800 mm diameter 0.8 km for 200,000 cu m/d;

(c) construction of water treatment plant with a capacity of 185,000 cu m/d;

(d) construction of 36 km treated water pipeline with diameters 1,350 mm to 900 mm diameter, 2.0 km lined tunnel; and

(e) construction of booster pump station structure for 370,000 cu m/d with pumps and equipment for 185,000 cu m/d.

Masan

(a) construction of 12 km of distribution pipelines 1200-300 mm diameter;

(b) upgrading of 5 booster pump stations each of 5,000 cu m/d;

(c) construction of two service reservoirs each with total storage of 11,000 cu m;

(d) constructing local improvements to distribution system;

(e) acquisition of leakage equipment including detectors and waste water meters;

(f) implementing leakage reduction program;

(g) constructing and equipping operational buildings;

(h) land acquisition and compensation; and

(i) consultant services for engineering and supervision of construction and staff training.

Changwon

(a) construction of local improvements to the distribution system;

(b) acquisition of leakage equipment including detectors and waste water meters;

(c) implementing leakage control program;

(d) construction and equipment of operational buildings;

(e) land acquisition and compensation; and

(f) consultant services for engineering and supervision of construction and training.

Jinhae

(a) replacement of raw water transmission pipeline in tunnel section, 1.0 km long 800 mm diameter;

(b) construction of main raw water booster station structure for 45,000 cu m/d with pumps and equipment for 15,000 cu m/d;

(c) upgrading capacity of existing treatment plant by 15,000 cu m/d;

(d) upgrading existing treated water booster station;

(e) construction of 9.5 km distribution pipelines 700-300 mm diameter;

(f) construction of 4000 cu m service reservoir;

(g) construction of local improvements to the distribution systems;

(h) acquisition of leakage equipment including detectors and waste water meters;

(i) implementing leakage control program;

(j) construction and equipment of operational buildings;

(k) land acquisition and compensation; and

(l) consultant services for engineering and supervision of construction and training.

Part B

Technical Assistance

Preparation of future projects including manpower development and training

Ministry of Construction - Water Supply Bureau

(a) Consultant services for preparation of master plans, feasibility studies, detailed designs and tendering services for water supply projects;

(b) consultant services for management, manpower survey, and training.

Part C

Pollution Monitoring Program

Environmental studies (including laboratory experiments) to be carried out by Office of the Environment

(a) assess and monitor air, water and soil pollution in the Nagdong River Basin and in the Masan Region;

(b) design and implement a pollution management program taking into account and coordinating the results of the pollution study carried;

(c) establish and carry out a staffing, training and investment program for the abatement of environmental pollution resulting from industrial and domestic waste water disposal.

PROJECT COST ESTIMATES

GWANGJU CITY WATER

LOCAL COST COMPONENT GIVEN IN WN MILLON, FOREIGN COST COMPONENT IN US$ MILLON

WORKS		TOTAL		1981		1982		1983		1984		1985	
		WN	US$	WN	US$	WN	US$	WN	US$	WN	US$	WN	US$
DONGBOK DAM/RESERVOIR	1	4000.000	6.050	0.000	0.000	1600.000	2.420	1600.000	2.420	800.000	1.210	0.000	0.000
INTAKE WORKS	1	820.000	0.880	0.000	0.000	328.000	0.352	328.000	0.352	164.000	0.176	0.000	0.000
RAW WATER TRANSMISS	1	5990.000	8.970	0.000	0.000	2396.000	3.588	2396.000	3.588	1198.000	1.794	0.000	0.000
TREATMENT PLANT	1	3440.000	4.570	0.000	0.000	1376.000	0.000	1376.000	3.428	688.000	1.142	0.000	0.000
TOTAL CATEGORY1	(W)	14250.000	20.470	0.000	0.000	5700.000	6.360	5700.000	9.788	2850.000	4.323	0.000	0.000
TRT WATER MAIN/DIST	1	2270.000	3.410	0.000	0.000	794.500	1.194	908.000	1.364	567.500	0.853	0.000	0.000
RESERVOIRS/BOOST STN	1	550.000	0.450	0.000	0.000	220.000	0.180	330.000	0.270	0.000	0.000	0.000	0.000
LEAK REDUCTION EQUIP	1	20.000	0.130	0.000	0.000	20.000	0.130	0.000	0.000	0.000	0.000	0.000	0.000
LEAK REDUCTION PROGM	1	830.000	1.280	0.000	0.000	207.500	0.218	207.500	0.358	207.500	0.346	207.500	0.358
LOCAL IMPROVEMENTS	1	860.000	0.850	0.000	0.000	215.000	0.213	215.000	0.213	215.000	0.213	215.000	0.213
ENGINEERING	1	1360.000	1.950	272.000	0.293	272.000	0.585	272.000	0.585	272.000	0.390	272.000	0.098
TAXES AND DUTIES	1	3320.000	0.000	0.000	0.000	1328.000	0.000	1328.000	0.000	498.000	0.000	166.000	0.000
TOTAL CATEGORY2	(W)	9210.000	8.070	272.000	0.293	3057.000	2.519	3260.500	2.790	1760.000	1.801	860.500	0.668
LAND AND COMPENSATE	1	9810.000	0.000	0.000	0.000	9810.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SERVICE CONNECTIONS	1	890.000	0.880	0.000	0.000	222.500	0.220	222.500	0.220	222.500	0.220	222.500	0.220
TOTAL CATEGORY 3	(W)	10700.000	0.880	0.000	0.000	10032.500	0.220	222.500	0.220	222.500	0.220	222.500	0.220
BASIC COST		34160.000	29.420	272.000	0.293	18789.500	9.099	9183.000	12.797	4832.500	6.343	1083.000	0.888
TECHNICAL CONTING.		3593.500	2.898	27.200	0.029	1662.325	0.899	1192.175	1.269	614.625	0.623	97.175	0.078
TOTAL CONSTANT PRICE		37753.500	32.318	299.200	0.322	20451.825	9.997	10375.175	14.066	5447.125	6.966	1180.175	0.966
PRICE CONTINGENCIES		5928.110	3.947	0.000	0.000	1431.628	0.425	2103.048	1.768	1824.771	1.464	568.663	0.291
TOTAL COSTS		43681.610	36.265	299.200	0.322	21883.453	10.422	12478.223	15.834	7271.896	8.430	1748.838	1.257

INVESTMENT SUMMARY

	WN MILLION			US$ MILLION				US$ MILLION				
	LOCAL	FOREIGN	TOTAL	LOCAL	FOREIGN	TOTAL	%	1981	1982	1983	1984	1985
TOTAL CATEGORY1	14250.00	13510.20	27760.20	21.59	20.47	42.06	41.1	0.00	15.00	18.42	8.64	0.00
TOTAL CATEGORY2	9210.00	5326.20	14536.20	13.95	8.07	22.02	21.5	0.70	7.15	7.73	4.47	1.97
TOTAL CATEGORY 3	10700.00	580.80	11280.80	16.21	0.88	17.09	16.7	0.00	15.42	0.56	0.56	0.56
BASIC COST	34160.00	19417.20	53577.20	51.76	29.42	81.18	79.2	0.70	37.57	26.71	13.67	2.53
TECHNICAL CONTING.	3593.50	1912.68	5506.18	5.44	2.90	8.34	8.1	0.07	3.42	3.08	1.55	0.23
TOTAL CONSTANT PRICE	37753.50	21329.88	59083.38	57.20	32.32	89.52	87.4	0.78	40.99	29.79	15.22	2.75
PRICE CONTINGENCIES	5928.11	2605.21	8533.32	8.98	3.95	12.93	12.6	0.00	2.59	4.95	4.23	1.15
TOTAL COSTS 2/	43681.61	23935.09	67616.70	66.18	36.27	102.45	100.0	0.78	43.58	34.74	19.45	3.91

PROJECT COST ESTIMATES

DAEGU CITY WATER

LOCAL COST COMPONENT GIVEN IN WN MILLON, FOREIGN COST COMPONENT IN US$ MILLON

WORKS		TOTAL		1981		1982		1983		1984		1985	
		WN	US$	WN	US$	WN	US$	WN	US$	WN	US$	WN	US$
RIVER INTAKE	1	590.000	0.930	0.000	0.000	590.000	0.930	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL CATEGORY 1	(W)	590.000	0.930	0.000	0.000	590.000	0.930	0.000	0.000	0.000	0.000	0.000	0.000
RAW WATER PIPELINE	1	610.000	0.810	0.000	0.000	610.000	0.810	0.000	0.000	0.000	0.000	0.000	0.000
TREATMENT PLANT	1	6100.000	8.120	0.000	0.000	1525.000	0.000	3050.000	4.060	1525.000	4.060	0.000	0.000
TREATED WATER PIPE	1	5200.000	7.000	0.000	0.000	1560.000	2.100	2080.000	2.800	1560.000	2.100	0.000	0.000
TOTAL CATEGORY 2	(W)	11910.000	15.930	0.000	0.000	3695.000	2.910	5130.000	6.860	3085.000	6.160	0.000	0.000
SERVICE RESERVOIR	1	840.000	0.710	0.000	0.000	0.000	0.000	840.000	0.710	0.000	0.000	0.000	0.000
BOOSTER STATION	1	130.000	0.150	0.000	0.000	0.000	0.000	130.000	0.150	0.000	0.000	0.000	0.000
LEAK REDUCTION EQUIP	1	50.000	0.490	0.000	0.000	15.000	0.147	20.000	0.196	15.000	0.147	0.000	0.000
LEAK REDUCTION PROGM	1	1550.000	2.090	0.000	0.000	465.000	0.627	620.000	0.836	465.000	0.627	0.000	0.000
ENGINEERING	1	1080.000	1.460	270.000	0.365	270.000	0.365	270.000	0.365	270.000	0.365	0.000	0.000
LAND PURCHASE	1	1310.000	0.000	0.000	0.000	1310.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LOCAL IMPROVEMENTS	1	2970.000	0.000	0.000	0.000	891.000	0.000	1188.000	0.000	891.000	0.000	0.000	0.000
TAXES AND DUTIES	1	2860.000	0.000	0.000	0.000	1144.000	0.000	1144.000	0.000	429.000	0.000	143.000	0.000
TOTAL CATEGORY 3	(W)	10790.000	4.900	270.000	0.365	4095.000	1.139	4212.000	2.257	2070.000	1.139	143.000	0.000
BASIC COST		23290.000	21.760	270.000	0.365	8380.000	4.979	9342.000	9.117	5155.000	7.299	143.000	0.000
TECHNICAL CONTING.		3013.000	2.176	27.000	0.037	1111.250	0.498	1190.700	0.912	669.750	0.730	14.300	0.000
TOTAL CONSTANT PRICE		26303.000	23.936	297.000	0.402	9491.250	5.477	10532.700	10.029	5824.750	8.029	157.300	0.000
PRICE CONTINGENCIES		4826.434	3.180	0.000	0.000	664.387	0.203	2134.978	1.260	1951.274	1.687	75.794	0.000
TOTAL COSTS		31129.434	27.116	297.000	0.402	10155.638	5.710	12667.678	11.289	7776.024	9.716	233.094	0.000

INVESTMENT SUMMARY

	-------WN MILLION-------			------US$ MILLION------				------US$ MILLION------				
	LOCAL	FOREIGN	TOTAL	LOCAL	FOREIGN	TOTAL	%	1981	1982	1983	1984	1985
TOTAL CATEGORY 1	590.00	613.80	1203.80	0.89	0.93	1.82	2.5	0.00	1.82	0.00	0.00	0.00
TOTAL CATEGORY 2	11910.00	10513.80	22423.80	18.05	15.93	33.98	46.7	0.00	8.51	14.63	10.83	0.00
TOTAL CATEGORY 3	10790.00	3234.00	14024.00	16.35	4.90	21.25	28.6	0.77	7.34	8.64	4.28	0.22
BASIC COST	23290.00	14361.60	37651.60	35.29	21.76	57.05	76.8	0.77	17.68	23.27	15.11	0.22
TECHNICAL CONTING.	3013.00	1436.16	4449.16	4.57	2.18	6.74	9.1	0.08	2.18	2.72	1.74	0.02
TOTAL CONSTANT PRICE	26303.00	15797.76	42100.76	39.86	23.94	63.79	85.9	0.85	19.86	25.99	16.85	0.24
PRICE CONTINGENCIES	4826.43	2098.96	6925.39	7.31	3.18	10.49	14.1	0.00	1.24	4.50	4.64	0.11
TOTAL COSTS 2/	31129.43	17896.72	49026.15	47.17	27.12	74.28	100.0	0.85	21.10	30.48	21.50	0.35

PROJECT COST ESTIMATES

MASAN CITY WATER

LOCAL COST COMPONENT GIVEN IN WN MILLON, FOREIGN COST COMPONENT IN US$ MILLON

WORKS		TOTAL		1981		1982		1983		1984	
		WN	US$	WN	US$	WN	US$	WN	US$	WN	US$
RIVER INTAKE	1	240.000	0.460	0.000	0.000	240.000	0.460	0.000	0.000	0.000	0.000
TOTAL CATEGORY 1	(W)	240.000	0.460	0.000	0.000	240.000	0.460	0.000	0.000	0.000	0.000
RAW WATER TRANSMISS	1	70.000	0.100	0.000	0.000	70.000	0.100	0.000	0.000	0.000	0.000
TREATMENT PLANT	1	2550.000	3.300	0.000	0.000	765.000	0.990	1020.000	1.650	765.000	0.660
TRTD WATER MAIN/DSBN	1	4590.000	5.970	0.000	0.000	1836.000	2.388	1836.000	2.388	918.000	1.194
TOTAL CATEGORY 2	(W)	7210.000	9.370	0.000	0.000	2671.000	3.478	2856.000	4.038	1683.000	1.854
BOOSTER PUMPING STN	1	50.000	0.070	0.000	0.000	0.000	0.000	50.000	0.070	0.000	0.000
SERVICE RESERVOIR	1	160.000	0.130	0.000	0.000	0.000	0.000	160.000	0.130	0.000	0.000
LOCAL IMPROVEMENTS	1	710.000	0.000	0.000	0.000	213.000	0.000	284.000	0.000	213.000	0.000
LEAK REDUCTION/EQPT	1	260.000	0.350	0.000	0.000	78.000	0.350	104.000	0.000	78.000	0.000
OPERATIONAL BLDGS/EQ	1	30.000	0.240	0.000	0.000	0.000	0.000	30.000	0.240	0.000	0.000
LAND AQN/COMPENSATIO	1	430.000	0.000	0.000	0.000	430.000	0.000	0.000	0.000	0.000	0.000
ENGINEERING/SUPERVSN	1	600.000	0.820	150.000	0.123	180.000	0.246	150.000	0.246	120.000	0.205
TAXES AND DUTIES	1	1490.000	0.000	0.000	0.000	596.000	0.000	596.000	0.000	298.000	0.000
TOTAL CATEGORY 3	(W)	3730.000	1.610	150.000	0.123	1497.000	0.596	1374.000	0.686	709.000	0.205
BASIC COST		11180.000	11.440	150.000	0.123	4408.000	4.534	4230.000	4.724	2392.000	2.059
TECHNICAL CONTING.		1514.500	1.144	15.000	0.012	610.350	0.453	565.800	0.472	323.350	0.206
TOTAL CONSTANT PRICE		12694.500	12.584	165.000	0.135	5018.350	4.987	4795.800	5.196	2715.350	2.265
PRICE CONTINGENCIES		2233.027	1.341	0.000	0.000	351.285	0.212	972.109	0.653	909.634	0.476
TOTAL COSTS		14927.527	13.925	165.000	0.135	5369.635	5.199	5767.909	5.850	3624.984	2.741

INVESTMENT SUMMARY

	WN MILLION			US$ MILLION				US$ MILLION			
	LOCAL	FOREIGN	TOTAL	LOCAL	FOREIGN	TOTAL	%	1981	1982	1983	1984
TOTAL CATEGORY 1	240.00	303.60	543.60	0.36	0.46	0.82	2.3	0.00	0.82	0.00	0.00
TOTAL CATEGORY 2	7210.00	6184.20	13394.20	10.92	9.37	20.29	55.5	0.00	7.52	8.37	4.40
TOTAL CATEGORY 3	3730.00	1062.60	4792.60	5.65	1.61	7.26	19.9	0.35	2.86	2.77	1.28
BASIC COST	11180.00	7550.40	18730.40	16.94	11.44	28.38	77.7	0.35	11.21	11.13	5.68
TECHNICAL CONTING.	1514.50	755.04	2269.54	2.29	1.14	3.44	9.4	0.04	1.38	1.33	0.70
TOTAL CONSTANT PRICE	12694.50	8305.44	20999.94	19.23	12.58	31.82	87.1	0.39	12.59	12.46	6.38
PRICE CONTINGENCIES	2233.03	885.04	3118.07	3.38	1.34	4.72	12.9	0.00	0.74	2.13	1.85
TOTAL COSTS 2/	14927.53	9190.48	24118.01	22.62	13.92	36.54	100.0	0.39	13.34	14.59	8.23

PROJECT COST ESTIMATES

CHANGWON CITY WATER

LOCAL COST COMPONENT GIVEN IN WN MILLON, FOREIGN COST COMPONENT IN US$ MILLON

WORKS		TOTAL WN	TOTAL US$	1981 WN	1981 US$	1982 WN	1982 US$	1983 WN	1983 US$	1984 WN	1984 US$
RIVER INTAKE	1	120.000	0.220	0.000	0.000	120.000	0.220	0.000	0.000	0.000	0.000
TOTAL CATEGORY 1	(W)	120.000	0.220	0.000	0.000	120.000	0.220	0.000	0.000	0.000	0.000
RAW WATER TRANSMI/SS	1	40.000	0.440	0.000	0.000	40.000	0.440	0.000	0.000	0.000	0.000
TREATMENT PLANT	1	1280.000	1.650	0.000	0.000	384.000	0.495	640.000	0.825	256.000	0 330
TRTD WATER MAIN/DSBN	1	2300.000	3.000	0.000	0.000	920.000	1.200	920.000	1.200	460.000	0.600
TOTAL CATEGORY 2	(W)	3620.000	5.090	0.000	0.000	1344.000	2.135	1560.000	2.025	716.000	0.930
BOOSTER PUMPING STN	1	30.000	0.030	0.000	0.000	0.000	0.000	30.000	0.030	0.000	0.000
SERVICE RESERVOIR	1	80.000	0.070	0.000	0.000	0.000	0.000	80.000	0.070	0.000	0.000
LOCAL IMPROVEMENTS	1	360.000	0.000	0.000	0.000	108.000	0.000	144.000	0.000	108.000	0.000
LEAK REDUCTION/EQT	1	130.000	0.170	0.000	0.000	39.000	0.170	52.000	0.000	39.000	0.000
OPERATIONAL BLDS/EQT	1	20.000	0.140	0.000	0.000	0.000	0.000	20.000	0.140	0.000	0.000
LAND AQN/COMPENSATION	1	210.000	0.000	0.000	0.000	210.000	0.000	0.000	0.000	0.000	0.000
ENGINEERING SUPERVSN	1	310.000	0.400	77.500	0.080	77.500	0.120	77.500	0.100	77.500	0.100
TAXES AND DUTIES	1	750.000	0.000	0.000	0.000	300.000	0.000	300.000	0.000	150.000	0.000
TOTAL CATEGORY 3	(W)	1890.000	0.810	77.500	0.080	734.500	0.290	703.500	0.340	374.500	0.100
BASIC COST		5630.000	6.120	77.500	0.080	2198.500	2.645	2263.500	2.365	1090.500	1.030
TECHNICAL CONTING.		762.000	0.612	7.750	0.008	305.050	0.265	304.350	0.236	144.850	0.103
TOTAL CONSTANT PRICE		6392.000	6.732	85.250	0.088	2503.550	2.910	2567.850	2.602	1235.350	1.133
PRICE CONTINGENCIES		1109.590	0.689	0.000	0.000	175.249	0.124	520.503	0.327	413.839	0.238
TOTAL COSTS		7501.590	7.421	85.250	0.088	2678.799	3.033	3088.353	2.928	1649.189	1.371

INVESTMENT SUMMARY

	WN MILLION LOCAL	WN MILLION FOREIGN	WN MILLION TOTAL	US$ MILLION LOCAL	US$ MILLION FOREIGN	US$ MILLION TOTAL	%	US$ MILLION 1981	1982	1983	1984
TOTAL CATEGORY 1	120.00	145.20	265.20	0.18	0.22	0.40	2.1	0 00	0.40	0.00	0.00
TOTAL CATEGORY 2	3620.00	3359.40	6979.40	5.48	5.09	10.57	56.3	0.00	4.17	4.39	2.01
TOTAL CATEGORY 3	1890.00	534.60	2424.60	2.86	0.81	3.67	19.6	0.20	1.40	1.41	0.67
BASIC COST	5630.00	4039.20	9669.20	8.53	6.12	14.65	78.0	0.20	5.98	5.79	2.68
TECHNICAL CONTING.	762.00	403.92	1165.92	1.15	0.61	1.77	9.4	0.02	0.73	0.70	0.32
TOTAL CONSTANT PRICE	6392.00	4443.12	10835.12	9.68	6.73	16.42	87.4	0.22	6.70	6.49	3.00
PRICE CONTINGENCIES	1109.59	454.53	1564.12	1.68	0.69	2.37	12.6	0.00	0.39	1.12	0.87
TOTAL COSTS 2/	7501.59	4897.65	12399.24	11.37	7.42	18.79	100.0	0.22	7.09	7.61	3.87

PROJECT COST ESTIMATES

JINHAE CITY WATER

LOCAL COST COMPONENT GIVEN IN WN MILLON, FOREIGN COST COMPONENT IN US$ MILLON

WORKS		TOTAL		1981		1982		1983		1984	
		WN	US$	WN	US$	WN	US$	WN	US$	WN	US$
TRANS PIPE REPLACMNT	1	80.000	0.110	0.000	0.000	40.000	0.055	40.000	0.055	0.000	0.000
MAIN BOOSTER PUMPSTN	1	100.000	0.130	0.000	0.000	50.000	0.065	50.000	0.065	0.000	0.000
UPGRD TREATMT PLANT	1	120.000	0.150	0.000	0.000	24.000	0.030	96.000	0.120	0.000	0.000
DISTBN PIPELINES	1	430.000	0.580	0.000	0.000	215.000	0.290	215.000	0.290	0.000	0.000
UPGRD EXST BOOST STN	1	40.000	0.050	0.000	0.000	0.000	0.000	40.000	0.050	0.000	0.000
SERVICE RESERVOIRS	1	80.000	0.070	0.000	0.000	80.000	0.070	0.000	0.000	0.000	0.000
LOCAL IMPROVEMENTS	1	150.000	0.000	0.000	0.000	45.000	0.000	60.000	0.000	45.000	0.000
LEAKAGE REDUCTION	1	140.000	0.170	0.000	0.000	42.000	0.170	56.000	0.000	42.000	0.000
	1	10.000	0.110	0.000	0.000	5.000	0.055	5.000	0.055	0.000	0.000
LAND ACQUISITION	1	40.000	0.000	0.000	0.000	40.000	0.000	0.000	0.000	0.000	0.000
ENGINEERING	1	70.000	0.090	24.500	0.023	21.000	0.036	14.000	0.018	10.500	0.014
TAXES AND DUTIES	1	150.000	0.000	0.000	0.000	45.000	0.000	75.000	0.000	30.000	0.000
SUBTOTAL	(W)	1410.000	1.460	24.500	0.023	607.000	0.771	651.000	0.653	127.500	0.014
BASIC COST		1410.000	1.460	24.500	0.023	607.000	0.771	651.000	0.653	127.500	0.014
TECHNICAL CONTING.		141.000	0.146	2.450	0.002	60.700	0.077	65.100	0.065	12.750	0.001
TOTAL CONSTANT PRICE		1551.000	1.606	26.950	0.025	667.700	0.848	716.100	0.718	140.250	0.015
PRICE CONTINGENCIES		238.876	0.129	0.000	0.000	46.739	0.036	145.153	0.090	46.983	0.003
TOTAL COSTS		1789.876	1.735	26.950	0.025	714.439	0.884	861.253	0.809	187.233	0.018

INVESTMENT SUMMARY

	WN MILLION			US$ MILLION				US$ MILLION			
	LOCAL	FOREIGN	TOTAL	LOCAL	FOREIGN	TOTAL	%	1981	1982	1983	1984
SUBTOTAL	1410.00	963.60	2373.60	2.14	1.46	3.60	80.9	0.06	1.69	1.64	0.21
BASIC COST	1410.00	963.60	2373.60	2.14	1.46	3.60	80.9	0.06	1.69	1.64	0.21
TECHNICAL CONTING.	141.00	96.36	237.36	0.21	0.15	0.36	8.1	0.01	0.17	0.16	0.02
TOTAL CONSTANT PRICE	1551.00	1059.96	2610.96	2.35	1.61	3.96	89.0	0.07	1.86	1.80	0.23
PRICE CONTINGENCIES	238.88	85.43	324.31	0.36	0.13	0.49	11.0	0.00	0.11	0.31	0.07
TOTAL COSTS 2/	1789.88	1145.39	2935.27	2.71	1.74	4.45	100.0	0.07	1.97	2.11	0.30

ANNEX 5

KOREA

FIRST WATER SUPPLY PROJECT

Estimated Schedule of Disbursements

IBRD fiscal year and quarter ending	Cumulative disbursements at end of quarter US$ million
1982	
March 31, 1982	2.7 a/
June 30, 1982	7.9
1983	
September 30, 1982	15.8
December 31, 1982	26.3
March 31, 1983	30.1
June 30, 1983	37.5
1984	
September 30, 1983	48.7
December 31, 1983	63.6
March 31, 1984	66.0
June 30, 1984	70.7
1985	
September 30, 1984	77.7
December 31, 1984	87.1
March 31, 1985	87.7
June 30, 1985	88.5
1986	
September 30, 1985	89.5
December 31, 1985	90.0

/a Includes $1.0 million retroactive financing for detailed design.

GWANJU CITY WATER — INCOME STATEMENT — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION-THOUSAND	727.00	760.00	795.00	832.00	870.00	910.00	952.00	995.00	1039.00	1089.00
POPULATION SERVED- WATER	540.64	599.51	642.01	682.51	731.31	777.71	821.71	863.31	902.51	939.31
% POPULATION SERVED- WATER	74.37	78.88	80.76	82.03	84.06	85.46	86.31	86.76	86.86	86.25
CONNECTIONS- WATER	49.60	55.00	60.00	65.00	71.00	77.00	83.00	89.00	95.00	101.00
VOLUME SOLD-MILLION M3	23.68	23.76	24.16	29.96	31.40	38.04	46.19	50.73	55.34	60.00
CONSUMPTION/CONNEC/MONTH	39.79	36.01	33.55	38.41	36.86	41.17	46.37	47.50	48.55	49.50
% UNACCOUNTED FOR WATER	40.00	40.00	39.00	38.00	35.00	33.00	30.00	30.00	30.00	30.00
PRODUCTION-MILL. M3	39.47	39.61	39.60	48.33	48.31	56.77	65.98	72.47	79.06	85.71
PER CAPITA PRODUCTION LCD	200.00	181.00	169.00	194.00	181.00	200.00	220.00	230.00	240.00	250.00
AVERAGE WATER TARIFF / M3	67.70	103.00	155.70	200.00	245.00	290.00	330.00	414.25	449.68	488.78
WATER REVENUES	1603.14	2447.65	3761.26	5992.65	7693.91	11030.83	15241.98	21015.70	24885.91	29326.02
OTHER OPERATIONAL REVENUE	84.00	134.09	129.00	153.00	182.00	217.00	257.00	306.00	364.00	431.00
TOTAL REVENUES	1687.14	2581.74	3890.26	6145.65	7875.91	11247.83	15498.98	21321.70	25249.91	29757.02
WAGES- WATER	400.00	642.00	835.62	1014.06	1193.47	1380.73	1592.32	1831.36	2101.33	2406.14
CHEMICALS	55.00	87.00	80.39	109.70	123.20	161.80	210.48	259.46	317.03	384.84
POWER	500.00	798.00	875.20	1633.48	1879.39	1158.15	1478.01	1855.34	2332.24	2897.04
MATERIALS	100.00	156.00	205.80	266.50	353.58	459.69	588.47	755.61	982.30	1236.24
OTHER	30.00	52.71	70.99	88.57	106.99	126.29	147.83	171.80	198.41	227.89
DIRECT COSTS-WATER	1085.00	1735.71	2068.01	3112.31	3656.64	3286.66	4017.12	4873.57	5931.32	7152.15
OTHER INDIRECT COSTS	15.40	160.49	75.23	119.85	153.88	220.62	304.84	319.79	365.39	431.44
TOTAL COSTS	1100.40	1896.20	2143.23	3232.17	3810.51	3507.28	4321.96	5193.36	6296.70	7583.60
INCOME BEFORE DEPRECIATION	586.74	685.54	1747.03	2913.49	4065.39	7740.55	11177.03	16128.34	18953.21	22173.43
DEPRECIATION	421.44	547.50	686.69	882.83	1162.92	1954.85	3079.40	4127.22	4920.51	5838.73
INCOME BEFORE INTEREST	165.30	138.04	1060.34	2030.66	2902.47	5785.70	8097.62	12001.12	14032.70	16334.70
INTEREST CHARGED OPER.	132.00	130.00	141.00	139.00	137.00	898.57	3140.88	3677.73	7086.72	7362.09
NON OPER.REVENUES (+)	658.00	149.73	370.00	400.00	528.00	576.00	624.00	684.00	744.00	810.00
NET SURPLUS (+)	691.30	157.77	1289.34	2291.66	3293.47	5463.13	5580.75	9007.39	7689.99	9782.61
AVERAGE RATE BASE	9916.54	12503.84	14995.82	19175.65	25874.03	48884.59	88961.53	120011.20	140327.00	163347.02
*OPERATING RATIO %	65.22	73.45	55.09	52.59	48.38	31.18	27.89	24.36	24.94	25.49
*RATE OF RETURN %	1.67	1.10	7.07	10.59	11.22	11.84	9.10	10.00	10.00	10.00

GWANJU CITY WATER — FLOW OF FUNDS — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SOURCES OF FUNDS										
INCOME BEFORE DEPRECIATION	586.74	685.54	1747.03	2913.49	4065.39	7740.55	11177.03	16128.34	18953.21	22173.43
NON-OPER.REVENUES (NET)	658.00	149.73	370.00	400.00	528.00	576.00	624.00	684.00	744.00	810.00
GRANTS FOR OPERATION	0.00	351.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GROSS INTERNAL GENERATION	1244.74	1187.22	2117.03	3313.49	4593.39	8316.55	11801.03	16812.34	19697.21	22983.43
IBRD LOAN	0.00	0.00	0.00	6878.75	10450.49	5563.90	1042.00	0.00	0.00	0.00
NATIONAL LOANS	0.00	0.00	209.44	18423.42	14691.18	8402.74	3606.17	1180.47	979.20	77.66
OTHER LOANS	435.28	190.48	0.00	0.00	0.00	0.00	0.00	4900.00	8525.00	9610.00
TOTAL LOANS	435.28	190.48	209.44	25302.17	25141.67	13966.64	4648.17	6080.47	9504.20	9687.66
TOTAL SOURCES	1680.02	1377.70	2326.47	28615.66	29735.06	22283.19	16449.19	22892.80	29201.41	32671.09
APPLICATIONS OF FUNDS										
INVESTMENT IN PROJECT	0.00	0.00	511.56	28762.21	22928.71	12835.79	2578.43	0.00	0.00	0.00
CAPITALIZED INTEREST	0.00	0.00	1.70	1715.00	4641.64	6539.78	4932.44	4658.61	979.20	77.66
IMMEDIATE IMPROVEMTS	1440.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STAGE 11 DISTBN WKS.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	371.07	411.88	457.19
OTHER WORKS	0.00	0.00	0.00	0.00	0.00	0.00	2060.00	9000.00	10000.00	14000.00
TOTAL INVESTMENT	1440.02	750.00	513.26	30477.21	27570.36	19375.57	9570.87	14029.68	11391.08	14534.85
FOREIGN LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	997.30	1994.59	1994.59	1994.59	1994.59
NATIONAL LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1019.24	5771.72	11605.73
OTHER LOANS AMORTIZATION	184.00	204.00	214.00	203.00	192.00	939.00	403.00	136.00	122.00	118.00
TOTAL AMORTIZATION	184.00	204.00	214.00	203.00	192.00	1936.30	2397.59	3149.83	7888.31	13718.32
OPER.INTEREST LONG T.DEBT	132.00	130.00	141.00	139.00	137.00	898.57	3140.88	3677.73	7086.72	7362.09
TOTAL OPERATIONAL INTEREST	132.00	130.00	141.00	139.00	137.00	898.57	3140.88	3677.73	7086.72	7362.09
TOTAL DEBT SERVICE	316.00	334.00	355.00	342.00	329.00	2834.86	5538.47	6827.56	14975.03	21080.42
INCREASE IN WORK.CAPITAL	-86.00	336.70	1482.06	-2152.40	-457.17	1082.05	2159.59	1562.30	2731.22	-3348.71
OTHER ASSETS	10.00	-43.00	-23.84	-51.16	2292.87	-1009.29	-819.74	473.26	104.08	404.53
TOTAL APPLICATIONS	1680.02	1377.70	2326.47	28615.66	29735.06	22283.19	16449.19	22892.80	29201.41	32671.09
DEBT SERVICE RATIO	3.94	3.55	5.96	9.69	13.96	2.93	2.13	2.46	1.32	1.09
% CONTRIBUTION TO INVESTMENT	76.75	94.69	16.65	15.22	16.52	29.10	43.72	85.60	35.46	14.11

GWANJU CITY WATER — BALANCE SHEET — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
A S S E T S										
FIXED ASSETS IN OPER.	15596.02	20903.82	24875.55	33979.59	43548.71	86774.64	133182.71	161618.49	189846.41	227205.56
MINUS ACCUM.DEPRECIATION	4021.44	5775.37	7559.38	9500.52	11708.50	14951.29	19675.33	25966.84	33743.70	43294.23
NET FIXED ASSETS	11574.58	15128.45	17316.17	24479.07	31840.20	71823.35	113507.38	135651.65	156102.71	183911.33
WORK IN PROGRESS	879.00	1000.00	1513.26	26369.00	48108.00	29048.00	1756.00	2000.00	2941.20	1000.00
CASH AND BANKS	344.00	148.37	1519.61	1529.05	421.49	393.30	1489.52	3294.78	5763.68	2465.74
ACCOUNTS RECEIVABLE	103.00	194.06	319.00	503.94	645.82	922.32	1270.92	1748.38	2070.49	2440.08
INVENTARIES	158.00	176.77	143.10	112.86	143.03	149.16	191.75	243.62	311.84	389.06
TOTAL CURRENT ASSETS	605.00	519.20	1981.70	2145.86	1210.35	1464.78	2952.19	5286.78	8146.01	5294.88
OTHER ASSETS	118.00	75.00	51.16	0.00	2292.87	1283.58	463.84	937.11	1041.19	1445.72
TOTAL ASSETS	13176.58	16722.65	20862.29	52993.93	83451.42	103619.70	118679.41	143875.54	168231.11	191651.93
EQUITY AND LIABILITIES										
EQUITY	1772.00	1772.00	1772.00	1772.00	1772.00	1772.00	1772.00	1772.00	1772.00	1772.00
CONTRIBUTIONS	532.00	883.95	883.95	883.95	883.95	883.95	883.95	883.95	883.95	883.95
REVALUATION SURPLUS	6900.00	10372.37	13246.78	15671.04	18363.74	21866.16	29766.73	42252.54	57174.23	74345.52
OPERATIONAL SURPLUS	1080.30	1238.07	2527.41	4819.07	8112.54	13575.67	19156.42	28163.81	35853.80	45636.41
TOTAL EQUITY	10284.30	14266.39	18430.14	23146.06	29132.23	38097.79	51579.10	73072.31	95683.97	122637.88
LONG TERM DEBT(NET)	1534.28	1510.76	1517.20	26627.37	49832.74	61401.79	62900.12	61092.28	56878.15	63017.57
ACCOUNT PAYABLES	484.00	61.50	41.95	2358.50	1880.15	1052.54	380.35	1152.64	1280.66	1778.23
CURRENT MATURITIES	204.00	214.00	203.00	192.00	1936.30	2397.59	3149.83	7888.31	13718.32	3548.24
TOTAL CURRENT LIABILITIES	688.00	275.50	244.95	2550.50	3816.45	3450.13	3530.18	9040.95	14998.98	5326.47
TOTAL LIABILITIES	2892.28	2456.26	2432.15	29847.87	54319.19	65521.92	67100.31	70803.23	72547.14	69014.05
TOTAL EQUITY-LIABILITIES	13176.58	16722.65	20862.29	52993.93	83451.42	103619.70	118679.41	143875.54	168231.11	191651.93
*WORKING CAPITAL-MILLION	121.00	457.70	1939.76	-212.64	-669.81	412.24	2571.84	4134.13	6865.35	3516.64
*CURRENT RATIO	0.88	1.88	8.09	0.84	0.32	0.42	0.84	0.58	0.54	0.99
% DEBT/(DEBT+EQUITY)	12.98	9.58	7.61	53.50	63.11	61.71	54.94	45.54	37.28	33.94

GWANJU CITY WATER — MONITORING INDICATORS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION AND POPULATION SERVED										
POPULATION-THOUSAND	727.00	760.00	795.00	832.00	870.00	910.00	952.00	995.00	1039.00	1089.00
POPULATION WITH WATER	540.64	599.51	642.01	682.51	731.31	777.71	821.71	863.31	902.51	939.31
% WITH WATER	74.37	78.88	80.76	82.03	84.06	85.46	86.31	86.76	86.86	86.25
DEMAND										
CONNECTIONS- WATER	49.60	55.00	60.00	65.00	71.00	77.00	83.00	89.00	95.00	101.00
CONSUMPTION-MILLION M3	23.68	23.76	24.16	29.96	31.40	38.04	46.19	50.73	55.34	60.00
CONSUMPTION/CONN/ M3/MONTH	39.79	36.01	33.55	38.41	36.86	41.17	46.37	47.50	48.55	49.50
% UNACCOUNTED FOR WATER	40.00	40.00	39.00	38.00	35.00	33.00	30.00	30.00	30.00	30.00
PRODUCTION-MILLION M3	39.47	39.61	39.60	48.33	48.31	56.77	65.98	72.47	79.06	85.71
PER CAPITA PRODUCTION-LCD	200.00	181.00	169.00	194.00	181.00	200.00	220.00	230.00	240.00	250.00
COSTS										
EXCHANGE RATE 1US$ =	484.00	605.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00
COST US$/ M3 SOLD	0.10	0.13	0.13	0.16	0.18	0.14	0.14	0.16	0.17	0.19
INFLATION (%)	20.00	30.00	19.00	14.00	11.00	11.00	11.00	11.00	11.00	11.00
TOTAL INVESTMENT MILLION US$	2.98	1.24	0.78	46.18	41.77	29.36	14.50	21.26	17.26	22.02
ACCUM.PROJECT INVEST.US$	0.00	0.00	0.78	44.35	79.09	98.54	102.45	0.00	0.00	0.00
ACCUM. % PROJECT INVEST.	0.00	0.00	0.76	43.29	77.20	96.19	100.00	0.00	0.00	0.00
REVENUES										
OPERATING REVENUES-MILLION	1687.14	2581.74	3890.26	6145.65	7875.91	11247.83	15498.98	21321.70	25249.91	29757.02
AVERAGE TARIFF $/ M3 SOLD	67.70	103.00	155.70	200.00	245.00	290.00	330.00	414.25	449.68	488.78
AVERAGE TARIFF US $/ M3 SOLD	0.14	0.17	0.24	0.30	0.37	0.44	0.50	0.63	0.68	0.74
% INCREASE IN TARIFFS		52.14	51.17	28.45	22.50	18.37	13.79	25.53	8.55	8.70
ANALYSIS IN CONSTANT (1981) PRICES										
CONSTANT PRICE INDEX	70.25	80.79	100.00	116.28	130.70	145.08	161.04	178.76	198.42	220.24
AVERAGE TARIFF/VOLUME SOLD	96.37	127.50	155.70	171.99	187.45	199.89	204.92	231.74	226.63	221.93
TARIFF INCREASE		32.30	22.12	10.47	8.98	6.64	2.52	13.09	-2.20	-2.08
OPERATING COSTS-MILLION	1566.42	2347.17	2143.23	2779.57	2915.37	2417.45	2683.76	2905.29	3173.45	3443.26
% INCREASE OPERATING COSTS		49.84	-8.69	29.69	4.89	-17.08	11.02	8.25	9.23	8.50
FINANTIAL RATIOS										
% RATE OF RETURN	1.67	1.10	7.07	10.59	11.22	11.84	9.10	10.00	10.00	10.00
% OPERATING RATIO	65.22	73.45	55.09	52.59	48.38	31.18	27.89	24.36	24.94	25.49
DEBT SERVICE RATIO	3.94	3.55	5.96	9.69	13.96	2.93	2.13	2.46	1.32	1.09
% RECEIVABLES IN BILLING	6.11	7.52	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
% DEBT/(DEBT+EQUITY)	12.98	9.58	7.61	53.50	63.11	61.71	54.94	45.54	37.28	33.94

DAEGU WATER — INCOME STATEMENT — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION-THOUSAND	1554.00	1624.00	1697.00	1773.00	1853.00	1937.00	2024.00	2115.00	2210.00	2316.00
POPULATION SERVED- WATER	1417.15	1486.76	1557.14	1634.80	1712.63	1798.00	1883.63	1977.61	2075.48	2129.37
% POPULATION SERVED- WATER	91.19	91.55	91.76	92.21	92.42	92.82	93.06	93.50	93.91	91.94
CONNECTIONS- WATER	134.73	141.32	148.23	155.63	163.32	171.42	179.90	188.84	198.12	203.83
VOLUME SOLD-MILLION M3	70.63	75.71	77.71	79.82	81.68	94.45	108.85	123.02	138.70	149.50
CONSUMPTION/CONNEC/MONTH	43.68	44.65	43.69	42.74	41.68	45.92	50.42	54.29	58.34	61.12
% UNACCOUNTED FOR WATER	35.50	35.00	34.60	34.20	33.80	33.40	33.00	32.40	31.80	30.00
PRODUCTION-MILL. M3	109.50	116.48	118.82	121.31	123.38	141.82	162.46	181.98	203.37	213.57
PER CAPITA PRODUCTION LCD	211.70	214.64	209.07	203.30	197.38	216.10	236.30	252.12	268.46	274.79
AVERAGE WATER TARIFF / M3	64.38	83.70	102.00	145.00	190.00	240.00	260.00	285.85	308.51	333.25
WATER REVENUES	4547.00	6337.01	7926.42	11573.90	15519.20	22668.00	28301.00	35164.96	42789.84	49821.12
OTHER OPERATIONAL REVENUE	250.90	278.10	423.30	442.00	506.00	579.00	662.00	757.00	866.00	991.00
TOTAL REVENUES	4797.90	6615.11	8349.72	12015.90	16025.20	23247.00	28963.00	35921.96	43655.84	50812.12
WAGES- WATER	1018.56	1557.00	2052.21	2534.05	2991.67	3436.04	3908.34	4446.05	5056.37	5693.45
CHEMICALS	160.00	268.00	256.66	293.56	334.37	431.12	552.37	693.35	868.40	1020.87
POWER	1127.85	1719.00	2559.44	3240.11	3922.37	5364.93	7312.45	4494.96	5572.40	6535.29
MATERIALS	687.12	1020.00	1058.36	1206.13	1381.69	1582.21	1808.00	2069.69	2373.48	2649.79
WATER COST	0.00	0.00	0.00	0.00	0.00	1233.81	1540.15	1879.88	2292.01	2622.66
OTHER COST	537.37	805.37	1051.71	1274.18	1475.95	1678.93	1909.71	2172.45	2470.67	2781.96
DIRECT COSTS-WATER	3530.90	5369.37	6978.38	8548.03	10106.04	13727.03	17031.01	15756.37	18633.33	21304.02
OTHER INDIRECT COSTS	84.74	83.10	158.53	231.48	310.38	453.36	566.02	639.70	757.83	877.30
TOTAL COSTS	3615.64	5452.47	7136.91	8779.51	10416.42	14180.39	17597.03	16396.08	19391.16	22181.31
INCOME BEFORE DEPRECIATION	1182.26	1162.64	1212.81	3236.39	5608.78	9066.61	11365.97	19525.88	24264.68	28630.80
DEPRECIATION	938.75	1844.10	2426.03	3021.46	3497.56	4263.66	5521.79	6963.54	8638.74	10298.39
INCOME BEFORE INTEREST	243.50	-681.46	-1213.21	214.93	2111.21	4802.95	5844.18	12562.34	15625.95	18332.41
INTEREST CHARGED OPER.	325.30	234.15	354.16	194.61	180.46	448.11	2292.17	2389.12	4190.58	5116.28
NON OPER.REVENUES (+)	1081.30	443.80	518.25	606.80	692.10	793.80	898.88	1037.04	1178.56	787.98
NET SURPLUS (+)	999.50	-471.81	-1049.12	627.12	2622.85	5148.64	4450.89	11210.26	12613.92	14004.11
AVERAGE RATE BASE	33127.79	45679.01	57944.79	69974.00	76973.20	92711.52	123219.38	157029.27	195324.33	229155.10
*OPERATING RATIO %	75.36	82.42	85.47	73.07	65.00	61.00	60.76	45.64	44.42	43.65
*RATE OF RETURN %	0.74	-1.49	-2.09	0.31	2.74	5.18	4.74	8.00	8.00	8.00

DAEGU WATER — FLOW OF FUNDS — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SOURCES OF FUNDS										
INCOME BEFORE DEPRECIATION	1182.26	1162.64	1212.81	3236.39	5608.78	9066.61	11365.97	19525.88	24264.68	28630.80
NON-OPER.REVENUES (NET)	1081.30	443.80	518.25	606.80	692.10	793.80	898.88	1037.04	1178.56	787.98
GROSS INTERNAL GENERATION	2263.56	1606.44	1731.06	3843.19	6300.88	9860.41	12264.85	20562.92	25443.24	29418.78
OTHER CONTRIBUTIONS	3934.21	1941.25	3030.00	3100.00	3600.00	3610.00	3620.00	4050.00	4584.00	4573.00
IBRD LOAN	0.00	0.00	0.00	3768.38	7450.86	6412.48	264.99	0.00	0.00	0.00
NATIONAL LOANS	0.00	0.00	651.00	7426.07	8424.90	6819.11	2298.88	804.42	589.90	25.35
OTHER LOANS	1196.00	1183.00	1795.00	0.00	3780.00	8300.00	9650.00	1519.00	0.00	0.00
TOTAL LOANS	1196.00	1183.00	2446.00	11194.45	19655.76	21531.59	12213.87	2323.42	589.90	25.35
TOTAL SOURCES	7393.77	4730.69	7207.06	18137.64	29556.64	35001.99	28098.72	26936.34	30617.14	34017.13
APPLICATIONS OF FUNDS										
INVESTMENT IN PROJECT	0.00	0.00	561.99	13924.02	20118.54	14188.51	233.09	0.00	0.00	0.00
CAPITALIZED INTEREST	0.00	0.00	3.71	825.12	2593.42	4642.83	4388.17	4823.91	2463.90	25.35
GONGSAN DAM	3316.06	2095.00	3586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SERVICE CONNECTIONS	3537.81	1996.84	1926.00	2331.00	2659.00	3046.00	3483.00	3998.00	4530.00	4574.00
OTHER WORKS	0.00	2.44	0.00	0.00	3062.00	10310.00	15325.00	9836.00	2749.00	4976.00
TOTAL INVESTMENT	6853.87	4094.28	6077.70	17080.13	28432.96	32187.33	23429.26	18657.91	9742.90	9575.35
FOREIGN LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	745.70	1491.39	1491.39	1491.39	1491.39
NATIONAL LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	518.82	4551.03	5874.80
OTHER LOANS AMORTIZATION	233.40	233.50	516.83	204.10	211.96	882.00	226.60	153.00	9000.00	10000.00
TOTAL AMORTIZATION	233.40	233.50	516.83	204.10	211.96	1627.70	1717.99	2163.22	15042.42	17366.19
OPER.INTEREST LONG T.DEBT	325.30	234.15	354.16	194.61	180.46	448.11	2292.17	2389.12	4190.58	5116.28
TOTAL OPERATIONAL INTEREST	325.30	234.15	354.16	194.61	180.46	448.11	2292.17	2389.12	4190.58	5116.28
TOTAL DEBT SERVICE	558.70	467.65	870.99	398.71	392.42	2075.81	4010.16	4552.34	19233.00	22482.46
INCREASE IN WORK.CAPITAL	-99.10	-143.22	60.16	-359.31	-227.20	568.36	1509.64	4246.81	2296.74	1732.22
OTHER ASSETS	80.30	311.98	198.22	1018.10	958.45	170.50	-850.34	-520.71	-655.50	227.10
TOTAL APPLICATIONS	7393.77	4730.69	7207.06	18137.64	29556.64	35001.99	28098.72	26936.34	30617.14	34017.13
DEBT SERVICE RATIO	4.05	3.44	1.99	9.64	16.06	4.75	3.06	4.52	1.32	1.31
% CONTRIBUTION TO INVESTMENT	28.73	20.07	9.47	20.03	22.81	27.79	33.34	92.67	49.06	72.02

DAEGU WATER — BALANCE SHEET — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
A S S E T S										
FIXED ASSETS IN OPER.	56265.52	73145.17	97102.43	114929.90	130513.15	168690.93	218803.20	269866.46	336360.67	386333.69
MINUS ACCUM.DEPRECIATION	8801.13	13285.57	18235.86	23810.34	29927.04	37482.67	47127.55	59275.13	74434.13	92920.28
NET FIXED ASSETS	47464.39	59859.60	78866.57	91119.57	100586.12	131208.26	171675.65	210591.33	261926.54	293413.41
WORK IN PROGRESS	1530.70	5624.98	1643.00	14490.00	39982.00	48348.00	40221.00	31884.00	4818.00	1420.00
CASH AND BANKS	837.60	507.20	514.18	624.40	783.28	824.50	1101.87	4264.83	5288.07	6512.25
ACCOUNTS RECEIVABLE	374.00	523.07	684.68	985.30	1314.07	1906.25	2374.97	2945.60	3579.78	4166.59
INVENTARIES	103.00	265.46	315.60	359.93	411.85	483.20	566.49	663.13	778.05	880.96
TOTAL CURRENT ASSETS	1314.60	1295.73	1514.46	1969.63	2509.20	3213.95	4043.32	7873.56	9645.90	11559.80
OTHER ASSETS	97.20	409.18	607.40	1625.50	2583.95	2754.45	1904.11	1383.40	727.90	955.00
TOTAL ASSETS	50406.89	67189.49	82631.43	109204.70	145661.27	185524.67	217844.08	251732.30	277118.34	307348.21
EQUITY AND LIABILITIES										
EQUITY	3622.00	3622.00	3622.00	3622.00	3622.00	3622.00	3622.00	3622.00	3622.00	3622.00
CONTRIBUTIONS	5442.61	7383.86	10413.86	13513.86	17113.86	20723.86	24343.86	28393.86	32977.86	37550.86
REVALUATION SURPLUS	34261.33	48500.65	59873.97	70915.29	80938.44	92002.92	106435.83	125320.15	148485.19	177297.11
OPERATIONAL SURPLUS	2588.14	2116.33	1067.21	1694.33	4317.18	9465.82	13916.72	25126.98	37740.90	51745.01
TOTAL EQUITY	45914.09	61622.84	74977.04	89745.48	105991.49	125814.60	148318.40	182462.99	222825.96	270214.99
LONG TERM DEBT(NET)	4056.30	4722.47	6964.37	17946.86	35974.92	55788.52	65839.17	53120.17	36343.88	34832.80
ACCOUNT PAYABLES	203.00	327.35	485.92	1300.40	2067.16	2203.56	1523.29	1106.72	582.32	764.00
CURRENT MATURITIES	233.50	516.83	204.10	211.96	1627.70	1717.99	2163.22	15042.42	17366.19	1536.42
TOTAL CURRENT LIABILITIES	436.50	844.18	690.02	1512.36	3694.86	3921.55	3686.50	16149.14	17948.51	2300.42
TOTAL LIABILITIES	4492.80	5566.65	7654.39	19459.22	39669.78	59710.07	69525.67	69269.31	54292.39	37133.22
TOTAL EQUITY-LIABILITIES	50406.89	67189.49	82631.43	109204.70	145661.27	185524.67	217844.08	251732.30	277118.34	307348.21
*WORKING CAPITAL-MILLION	1111.60	968.38	1028.54	669.23	442.03	1010.39	2520.03	6766.84	9063.58	10795.80
*CURRENT RATIO	3.01	1.53	2.19	1.30	0.68	0.82	1.10	0.49	0.54	5.03
% DEBT/(DEBT+EQUITY)	8.12	7.12	8.50	16.66	25.34	30.72	30.74	22.55	14.02	11.42

DAEGU WATER — MONITORING INDICATORS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION AND POPULATION SERVED										
POPULATION-THOUSAND	1554.00	1624.00	1697.00	1773.00	1853.00	1937.00	2024.00	2115.00	2210.00	2316.00
POPULATION WITH WATER	1417.15	1486.76	1557.14	1634.80	1712.63	1798.00	1883.63	1977.61	2075.48	2129.37
% WITH WATER	91.19	91.55	91.76	92.21	92.42	92.82	93.06	93.50	93.91	91.94
DEMAND										
CONNECTIONS- WATER	134.73	141.32	148.23	155.63	163.32	171.42	179.90	188.84	198.12	203.83
CONSUMPTION-MILLION M3	70.63	75.71	77.71	79.82	81.68	94.45	108.85	123.02	138.70	149.50
CONSUMPTION/CONN/ M3/MONTH	43.68	44.65	43.69	42.74	41.68	45.92	50.42	54.29	58.34	61.12
% UNACCOUNTED FOR WATER	35.50	35.00	34.60	34.20	33.80	33.40	33.00	32.40	31.80	30.00
PRODUCTION-MILLION M3	109.50	116.48	118.82	121.31	123.38	141.82	162.46	181.98	203.37	213.57
PER CAPITA PRODUCTION-LCD	211.70	214.64	209.07	203.30	197.38	216.10	236.30	252.12	268.46	274.79
COSTS										
EXCHANGE RATE 1US$ =	484.00	605.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00
COST US$/ M3 SOLD	0.11	0.12	0.14	0.17	0.19	0.23	0.24	0.20	0.21	0.22
INFLATION (%)	20.00	30.00	19.00	14.00	11.00	11.00	11.00	11.00	11.00	11.00
TOTAL INVESTMENT MILLION US$	14.16	6.77	9.21	25.88	43.08	48.77	35.50	28.27	14.76	14.51
ACCUM.PROJECT INVEST.US$	0.00	0.00	0.85	21.95	52.43	73.93	74.28	0.00	0.00	0.00
ACCUM. % PROJECT INVEST.	0.00	0.00	1.15	29.55	70.58	99.52	100.00	0.00	0.00	0.00
REVENUES										
OPERATING REVENUES-MILLION	4797.90	6615.11	8349.72	12015.90	16025.20	23247.00	28963.00	35921.96	43655.84	50812.12
AVERAGE TARIFF $/ M3 SOLD	64.38	83.70	102.00	145.00	190.00	240.00	260.00	285.85	308.51	333.25
AVERAGE TARIFF US $/ M3 SOLD	0.13	0.14	0.15	0.22	0.29	0.36	0.39	0.43	0.47	0.50
% INCREASE IN TARIFFS		30.01	21.86	42.16	31.03	26.32	8.33	9.94	7.93	8.02
ANALYSIS IN CONSTANT (1981) PRICES										
CONSTANT PRICE INDEX	70.25	80.79	100.00	116.28	130.70	145.08	161.04	178.76	198.42	220.24
AVERAGE TARIFF/VOLUME SOLD	91.64	103.61	102.00	124.70	145.37	165.42	161.45	159.91	155.48	151.31
TARIFF INCREASE		13.05	-1.55	22.25	16.58	13.80	-2.40	-0.95	-2.77	-2.68
OPERATING COSTS-MILLION	5146.86	6749.21	7136.91	7550.12	7969.45	9774.06	10927.06	9172.35	9772.86	10071.22
% INCREASE OPERATING COSTS		31.13	5.74	5.79	5.55	22.64	11.80	-16.06	6.55	3.05
FINANTIAL RATIOS										
% RATE OF RETURN	0.74	-1.49	-2.09	0.31	2.74	5.18	4.74	8.00	8.00	8.00
% OPERATING RATIO	75.36	82.42	85.47	73.07	65.00	61.00	60.76	45.64	44.42	43.65
DEBT SERVICE RATIO	4.05	3.44	1.99	9.64	16.06	4.75	3.06	4.52	1.32	1.31
% RECEIVABLES IN BILLING	7.80	7.91	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
% DEBT/(DEBT+EQUITY)	8.12	7.12	8.50	16.66	25.34	30.72	30.74	22.55	14.02	11.42

MASAN CITY — INCOME STATEMENT — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION-THOUSAND	405.00	420.00	442.00	465.00	488.00	515.00	544.00	570.00	600.00	630.00
POPULATION SERVED- WATER	275.77	287.96	304.76	331.34	357.11	388.74	418.74	449.14	483.03	517.95
% POPULATION SERVED- WATER	68.09	68.56	68.95	71.26	73.18	75.48	76.97	78.80	80.51	82.21
CONNECTIONS- WATER	20.76	21.69	23.04	25.16	27.28	29.86	32.46	35.70	39.46	43.43
VOLUME SOLD-MILLION M3	8.28	8.83	9.43	10.06	10.72	14.98	18.48	22.65	26.99	31.20
CONSUMPTION/CONNEC/MONTH	33.24	33.94	34.11	33.32	32.75	41.81	47.44	52.87	57.00	59.87
% UNACCOUNTED FOR WATER	45.00	45.00	43.00	40.00	38.00	36.00	35.00	34.00	33.00	32.00
PRODUCTION-MILL. M3	15.05	16.06	16.54	16.77	17.29	23.41	28.43	34.32	40.28	45.88
PER CAPITA PRODUCTION LCD	149.56	152.80	148.73	138.64	132.65	164.96	186.02	209.34	228.49	242.70
AVERAGE WATER TARIFF / M3	87.00	98.50	159.50	220.00	290.00	315.00	335.00	353.58	374.21	393.46
WATER REVENUES	720.36	870.05	1504.08	2213.20	3108.80	4718.70	6190.80	8008.53	10099.98	12275.86
OTHER OPERATIONAL REVENUE	34.30	36.94	45.46	63.50	75.30	89.50	106.30	127.20	153.40	171.20
TOTAL REVENUES	754.66	906.99	1549.54	2276.70	3184.10	4808.20	6297.10	8135.73	10253.38	12447.06
WAGES- WATER	124.56	229.00	311.72	396.57	483.74	587.73	709.18	826.48	965.70	1125.86
CHEMICALS	60.22	114.00	97.44	110.49	127.60	85.20	115.71	156.49	205.85	262.91
POWER	149.04	275.00	218.38	251.50	292.21	444.72	682.34	912.86	1180.31	1477.41
MATERIALS	42.77	80.00	80.64	113.22	150.04	194.09	233.71	278.46	335.41	399.56
MOC WATER COST	230.00	412.00	354.04	390.66	439.17	203.63	269.52	354.51	454.00	563.44
OTHER COSTS	24.29	34.69	46.41	59.05	72.03	86.00	99.62	116.09	135.65	158.14
DIRECT COSTS-WATER	630.88	1144.69	1108.64	1321.50	1564.79	1601.37	2110.09	2644.89	3276.92	3987.31
OTHER INDIRECT COSTS	14.40	3.58	30.08	44.26	62.18	94.37	123.82	156.70	204.60	236.51
TOTAL COSTS	645.28	1148.27	1138.72	1365.76	1626.96	1695.74	2233.90	2801.59	3481.52	4223.82
INCOME BEFORE DEPRECIATION	109.38	-241.28	410.82	910.94	1557.14	3112.46	4063.20	5334.14	6771.86	8223.24
DEPRECIATION	228.14	297.00	373.88	434.76	500.71	842.30	1459.92	1970.34	2510.28	3082.61
INCOME BEFORE INTEREST	-118.76	-538.28	36.94	476.18	1056.43	2270.16	2603.27	3363.79	4261.58	5140.63
INTEREST CHARGED OPER.	48.40	73.20	45.00	43.00	41.80	143.34	1098.50	1134.54	1948.28	2007.40
NON OPER.REVENUES (+)	51.60	266.77	96.00	149.00	176.00	3715.00	254.00	326.00	428.00	430.00
NET SURPLUS (+)	-115.56	-344.71	87.94	582.18	1190.63	5841.82	1758.78	2555.26	2741.31	3563.23
AVERAGE RATE BASE	4206.08	5190.82	6076.43	6325.03	6565.21	14775.83	30546.61	42047.42	53269.79	64257.82
*OPERATING RATIO %	85.51	126.60	73.49	59.99	51.10	35.27	35.48	34.44	33.95	33.93
*RATE OF RETURN %	-2.82	-10.37	0.61	7.53	16.09	15.36	8.52	8.00	8.00	8.00

MASAN CITY — FLOW OF FUNDS — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SOURCES OF FUNDS										
INCOME BEFORE DEPRECIATION	109.38	-241.28	410.82	910.94	1557.14	3112.46	4063.20	5334.14	6771.86	8223.24
NON-OPER.REVENUES (NET)	51.60	266.77	96.00	149.00	176.00	3715.00	254.00	326.00	428.00	430.00
GRANTS FOR OPERATION	0.00	284.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GROSS INTERNAL GENERATION	160.98	309.76	506.82	1059.94	1733.14	6827.46	4317.20	5660.14	7199.86	8653.24
OTHER CONTRIBUTIONS	129.00	165.00	287.00	449.00	528.00	644.00	764.00	983.00	1281.00	1291.00
IBRD LOAN	0.00	0.00	0.00	3431.58	3860.68	1808.92	89.30	0.00	0.00	0.00
NATIONAL LOANS	0.00	0.00	82.50	3657.72	4752.34	3312.84	347.33	375.12	312.47	24.36
OTHER LOANS	298.25	227.00	0.00	0.00	350.00	3000.00	4000.00	4050.00	0.00	1000.00
TOTAL LOANS	298.25	227.00	82.50	7089.30	8963.02	8121.76	4436.63	4425.12	312.47	1024.36
TOTAL SOURCES	588.23	701.76	876.32	8598.24	11224.15	15593.22	9517.83	11068.25	8793.33	10968.60
APPLICATIONS OF FUNDS										
INVESTMENT IN PROJECT	0.00	0.00	254.30	8801.22	9628.59	5433.90	0.00	0.00	0.00	0.00
CAPITALIZED INTEREST	0.00	0.00	0.67	490.39	1389.91	2200.04	1837.62	2131.12	1422.47	1134.36
SERVICE CONNECTIONS	116.00	161.00	274.00	433.00	502.00	632.00	751.00	961.00	1251.00	1290.00
OTHER WORKS	290.60	340.00	0.00	0.00	0.00	5448.00	5020.00	5082.00	324.00	2544.00
TOTAL INVESTMENT	406.60	501.00	528.97	9724.60	11520.50	13713.94	7608.62	8174.12	2997.47	4968.36
FOREIGN LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	382.94	765.87	765.87	765.87	765.87
NATIONAL LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	248.79	1667.33	3619.37
OTHER LOANS AMORTIZATION	13.90	93.25	13.00	13.00	23.00	37.50	31.50	31.50	31.50	31.50
TOTAL AMORTIZATION	13.90	93.25	13.00	13.00	23.00	420.44	797.37	1046.17	2464.71	4416.74
OPER.INTEREST LONG T.DEBT	48.40	73.20	45.00	43.00	41.80	143.34	1098.50	1134.54	1948.28	2007.40
TOTAL DEBT SERVICE	62.30	166.45	58.00	56.00	64.80	563.78	1895.87	2180.70	4412.98	6424.14
INCREASE IN WORK.CAPITAL	118.33	-13.79	-46.31	-1223.60	-219.15	980.50	135.34	724.43	1075.88	-416.90
OTHER ASSETS	1.00	48.10	335.67	41.23	-142.00	335.00	-122.00	-11.00	307.00	-7.00
TOTAL APPLICATIONS	588.23	701.76	876.32	8598.24	11224.15	15593.22	9517.83	11068.25	8793.33	10968.60
DEBT SERVICE RATIO	2.58	1.86	8.74	18.93	26.75	12.11	2.28	2.60	1.63	1.35
% CONTRIBUTION TO INVESTMENT	22.53	29.93	12.52	13.83	14.32	57.21	24.63	55.58	51.80	51.70

MASAN CITY — BALANCE SHEET — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
A S S E T S										
FIXED ASSETS IN OPER.	7652.97	10346.86	12312.76	14036.55	16309.64	34738.64	53741.52	65673.20	86464.73	100360.21
MINUS ACCUM.DEPRECIATION	2987.83	4181.17	5349.48	6533.17	7752.53	9447.61	11946.76	15231.25	19416.96	24635.44
NET FIXED ASSETS	4665.14	6165.69	6963.28	7503.38	8557.11	25291.04	41794.75	50441.95	67047.76	75724.77
WORK IN PROGRESS	162.00	265.00	793.97	10518.57	21310.00	18389.00	10816.00	12970.00	2400.00	2984.00
CASH AND BANKS	217.80	206.29	159.44	293.04	133.55	263.20	261.92	859.66	1003.62	748.23
ACCOUNTS RECEIVABLE	76.60	90.60	127.06	186.69	261.10	394.27	516.36	667.13	840.78	1020.66
INVENTARIES	20.60	33.11	42.74	53.69	66.63	67.03	83.86	104.39	129.90	158.99
TOTAL CURRENT ASSETS	315.00	330.00	329.25	533.42	461.28	724.50	862.14	1631.18	1974.30	1927.88
OTHER ASSETS	2.00	50.10	385.77	427.00	285.00	620.00	498.00	487.00	794.00	787.00
TOTAL ASSETS	5144.14	6810.79	8472.27	18982.37	30613.39	45024.54	53970.89	65530.13	72216.07	81423.64
EQUITY AND LIABILITIES										
EQUITY	509.00	509.00	509.00	509.00	509.00	509.00	509.00	509.00	509.00	509.00
CONTRIBUTIONS	386.00	835.27	1122.27	1571.27	2099.27	2743.27	3507.27	4490.27	5771.27	7062.27
REVALUATION SURPLUS	3410.78	4810.32	5981.80	6956.66	7782.03	8723.32	11505.33	16102.75	21651.37	29026.62
OPERATIONAL SURPLUS	75.26	-269.45	-181.50	400.67	1591.30	7433.11	9191.89	11747.14	14488.45	18051.68
TOTAL EQUITY	4381.04	5885.15	7431.57	9437.60	11981.60	19408.70	24713.49	32849.17	42420.09	54649.57
LONG TERM DEBT(NET)	657.56	871.56	941.06	8007.36	16549.94	23874.33	27264.79	29225.20	25120.94	24400.20
ACCOUNT PAYABLES	12.29	41.08	86.64	1514.41	1661.42	944.14	946.44	991.05	258.30	628.78
CURRENT MATURITIES	93.25	13.00	13.00	23.00	420.44	797.37	1046.17	2464.71	4416.74	1745.09
TOTAL CURRENT LIABILITIES	105.54	54.08	99.64	1537.41	2081.85	1741.51	1992.61	3455.76	4675.04	2373.87
TOTAL LIABILITIES	763.10	925.64	1040.70	9544.77	18631.79	25615.84	29257.40	32680.96	29795.98	26774.08
TOTAL EQUITY-LIABILITIES	5144.14	6810.79	8472.27	18982.37	30613.39	45024.54	53970.89	65530.13	72216.07	81423.64
*WORKING CAPITAL-MILLION	302.71	288.92	242.61	-980.99	-1200.14	-219.64	-84.30	640.13	1716.00	1299.10
*CURRENT RATIO	2.98	6.10	3.30	0.35	0.22	0.42	0.43	0.47	0.42	0.81
% DEBT/(DEBT+EQUITY)	13.05	12.90	11.24	45.90	58.01	55.16	52.45	47.08	37.19	30.87

MASAN CITY	MONITORING INDICATORS									
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION AND POPULATION SERVED										
POPULATION-THOUSAND	405.00	420.00	442.00	465.00	488.00	515.00	544.00	570.00	600.00	630.00
POPULATION WITH WATER	275.77	287.96	304.76	331.34	357.11	388.74	418.74	449.14	483.03	517.95
% WITH WATER	68.09	68.56	68.95	71.26	73.18	75.48	76.97	78.80	80.51	82.21
DEMAND										
CONNECTIONS- WATER	20.76	21.69	23.04	25.16	27.28	29.86	32.46	35.70	39.46	43.43
CONSUMPTION-MILLION M3	8.28	8.83	9.43	10.06	10.72	14.98	18.48	22.65	26.99	31.20
CONSUMPTION/CONN/ M3/MONTH	33.24	33.94	34.11	33.32	32.75	41.81	47.44	52.87	57.00	59.87
% UNACCOUNTED FOR WATER	45.00	45.00	43.00	40.00	38.00	36.00	35.00	34.00	33.00	32.00
PRODUCTION-MILLION M3	15.05	16.06	16.54	16.77	17.29	23.41	28.43	34.32	40.28	45.88
PER CAPITA PRODUCTION-LCD	149.56	152.80	148.73	138.64	132.65	164.96	186.02	209.34	228.49	242.70
COSTS										
EXCHANGE RATE 1US$ =	484.00	605.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00
COST US$/ M3 SOLD	0.16	0.21	0.18	0.21	0.23	0.17	0.18	0.19	0.20	0.21
INFLATION (%)	20.00	30.00	19.00	14.00	11.00	11.00	11.00	11.00	11.00	11.00
TOTAL INVESTMENT MILLION US$	0.84	0.83	0.80	14.73	17.46	20.78	11.53	12.39	4.54	7.53
ACCUM.PROJECT INVEST.US$	0.00	0.00	0.39	13.72	28.31	36.54	0.00	0.00	0.00	0.00
ACCUM. % PROJECT INVEST.	0.00	0.00	1.05	37.55	77.47	100.00	0.00	0.00	0.00	0.00
REVENUES										
OPERATING REVENUES-MILLION	754.66	906.99	1549.54	2276.70	3184.10	4808.20	6297.10	8135.73	10253.38	12447.06
AVERAGE TARIFF $/ M3 SOLD	87.00	98.50	159.50	220.00	290.00	315.00	335.00	353.58	374.21	393.46
AVERAGE TARIFF US $/ M3 SOLD	0.18	0.16	0.24	0.33	0.44	0.48	0.51	0.54	0.57	0.60
% INCREASE IN TARIFFS		13.22	61.93	37.93	31.82	8.62	6.35	5.55	5.84	5.14
ANALYSIS IN CONSTANT (1982) PRICES										
CONSTANT PRICE INDEX	60.41	69.47	86.00	100.00	112.40	124.77	138.49	153.72	170.63	189.40
AVERAGE TARIFF/VOLUME SOLD	144.01	141.78	185.47	220.00	258.00	252.47	241.89	230.01	219.31	207.73
TARIFF INCREASE		-1.55	30.82	18.62	17.27	-2.14	-4.19	-4.91	-4.65	-5.28
OPERATING COSTS-MILLION	1068.13	1652.80	1324.14	1365.76	1447.45	1359.14	1613.04	1822.48	2040.34	2230.06
% INCREASE OPERATING COSTS		54.74	-19.89	3.14	5.98	-6.10	18.68	12.98	11.95	9.30
FINANTIAL RATIOS										
% RATE OF RETURN	-2.82	-10.37	0.61	7.53	16.09	15.36	8.52	8.00	8.00	8.00
% OPERATING RATIO	85.51	126.60	73.49	59.99	51.10	35.27	35.48	34.44	33.95	33.93
DEBT SERVICE RATIO	2.58	1.86	8.74	18.93	26.75	12.11	2.28	2.60	1.63	1.35
% RECEIVABLES IN BILLING	10.15	9.99	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
% DEBT/(DEBT+EQUITY)	13.05	12.90	11.24	45.90	58.01	55.16	52.45	47.08	37.19	30.87

CHANGWON CITY WATER — INCOME STATEMENT — MILLION WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION-THOUSAND	94.90	119.00	143.20	167.40	191.60	215.80	240.00	258.60	276.00	293.90
POPULATION SERVED- WATER	13.18	35.92	51.14	68.73	103.91	142.65	175.09	201.67	221.78	241.47
% POPULATION SERVED- WATER	13.89	30.18	35.71	41.06	54.23	66.10	72.95	77.98	80.36	82.16
CONNECTIONS- WATER	1.03	2.80	4.00	5.40	8.26	11.28	13.87	16.02	17.70	19.31
VOLUME SOLD-MILLION M3	0.57	1.28	1.90	2.73	3.56	6.92	9.71	12.32	15.00	17.68
CONSUMPTION/CONNEC/MONTH	46.12	38.10	39.58	42.13	35.94	51.12	58.34	64.09	70.62	76.30
% UNACCOUNTED FOR WATER	20.00	20.00	25.00	25.00	25.00	25.00	25.00	25.00	24.00	23.00
PRODUCTION-MILL. M3	0.71	1.60	2.53	3.64	4.75	9.23	12.95	16.43	19.74	22.96
PER CAPITA PRODUCTION LCD	148.08	122.05	135.72	145.10	125.24	177.21	202.58	223.17	243.82	260.52
AVERAGE WATER TARIFF / M3	55.00	63.77	103.29	134.00	175.00	200.00	240.00	251.96	267.71	282.64
WATER REVENUES	31.35	81.63	196.25	365.82	623.44	1384.00	2330.40	3104.09	4015.64	4997.01
OTHER OPERATIONAL REVENUE	1.20	2.47	4.00	6.10	8.30	12.10	16.30	21.00	25.00	28.00
TOTAL REVENUES	32.55	84.10	200.25	371.92	631.74	1396.10	2346.70	3125.09	4040.64	5025.01
WAGES- WATER	4.12	18.43	37.69	59.27	101.99	154.61	211.02	270.54	331.79	401.78
CHEMICALS	0.00	0.00	6.56	10.56	15.44	33.59	52.69	74.91	100.86	131.57
POWER	0.00	0.00	0.00	0.00	0.00	184.53	297.77	443.52	651.32	895.48
MATERIALS	0.30	8.90	14.08	20.90	34.94	62.04	139.39	175.58	212.05	251.03
MOC RAW WATER	0.00	0.00	0.00	0.00	0.00	80.27	122.73	169.69	222.43	281.96
MOC TREATED WATER	20.00	30.00	32.60	34.20	35.90	0.00	0.00	0.00	0.00	0.00
OTHER COST	2.37	7.40	14.25	21.39	30.26	46.04	62.73	79.67	97.00	108.00
DIRECT COSTS-WATER	26.79	64.73	105.18	146.31	218.53	561.08	886.34	1213.90	1615.44	2069.82
OTHER INDIRECT COSTS	0.00	0.65	1.96	5.49	12.47	27.68	46.61	74.41	90.60	104.31
TOTAL COSTS	26.79	65.38	107.14	151.80	231.00	588.76	932.95	1288.31	1706.04	2174.13
INCOME BEFORE DEPRECIATION	5.76	18.71	93.11	220.12	400.74	807.34	1413.75	1836.78	2334.60	2850.87
DEPRECIATION	0.89	9.65	23.34	46.79	84.20	263.62	480.80	596.46	765.97	946.34
INCOME BEFORE INTEREST	4.87	9.06	69.77	173.33	316.54	543.72	932.96	1240.32	1568.63	1904.54
INTEREST CHARGED OPER.	0.00	0.00	0.00	0.00	0.00	77.14	591.39	600.92	1259.89	1175.96
NON OPER.REVENUES (+)	53.00	40.16	72.00	92.40	208.78	243.11	229.21	209.63	180.60	189.18
NET SURPLUS (+)	57.87	49.22	141.77	265.73	525.32	709.69	570.78	849.03	489.34	917.75
AVERAGE RATE BASE	30.59	260.92	553.42	1127.33	2118.33	7898.13	14707.57	17718.84	22408.98	27207.65
*OPERATING RATIO %	82.30	77.75	53.50	40.82	36.57	42.17	39.76	41.22	42.22	43.27
*RATE OF RETURN %	15.92	3.47	12.61	15.38	14.94	6.88	6.34	7.00	7.00	7.00

CHANGWON CITY WATER — FLOW OF FUNDS — MILLION WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SOURCES OF FUNDS										
INCOME BEFORE DEPRECIATION	5.76	18.71	93.11	220.12	400.74	807.34	1413.75	1836.78	2334.60	2850.87
NON-OPER.REVENUES (NET)	53.00	40.16	72.00	92.40	208.78	243.11	229.21	209.63	180.60	189.18
GROSS INTERNAL GENERATION	58.76	58.87	165.11	312.52	609.52	1050.45	1642.97	2046.40	2515.20	3040.05
OTHER CONTRIBUTIONS	0.00	143.20	176.20	184.30	230.00	279.00	327.00	297.00	250.00	246.00
EQUITY INCREASE	100.41	847.53	136.36	1100.00	1400.00	610.00	1190.00	300.00	100.00	0.00
IBRD LOAN	0.00	0.00	0.00	2001.88	1932.79	962.98	0.00	0.00	0.00	0.00
NATIONAL LOANS	0.00	0.00	42.63	1339.40	1544.18	824.59	0.00	0.00	0.00	0.00
OTHER LOANS	0.00	0.00	0.00	0.00	0.00	975.00	200.00	1600.00	1600.00	700.00
TOTAL LOANS	0.00	0.00	42.63	3341.28	3476.97	2762.57	200.00	1600.00	1600.00	700.00
TOTAL SOURCES	159.17	1049.60	520.30	4938.10	5716.48	4702.03	3359.97	4243.40	4465.20	3986.05
APPLICATIONS OF FUNDS										
INVESTMENT IN PROJECT	0.00	0.00	143.33	4680.68	5021.15	2554.09	0.00	0.00	0.00	0.00
CAPITALIZED INTEREST	0.00	0.00	0.35	247.95	668.51	982.05	718.60	777.65	0.00	0.00
SERVICE CONNECTIONS	140.00	155.00	173.90	183.50	225.40	274.10	322.20	300.00	254.70	246.40
OTHER WORKS	0.00	900.00	50.00	0.00	0.00	0.00	0.00	0.00	450.00	620.00
PHASE II CAPITAL EXP	0.00	0.00	0.00	0.00	0.00	474.00	922.00	1931.40	1600.00	500.00
TOTAL INVESTMENT	140.00	1055.00	367.58	5112.13	5915.05	4284.23	1962.80	3009.05	2304.70	1366.40
FOREIGN LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	204.07	408.14	408.14	408.14	408.14
NATIONAL LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	125.03	250.05	250.05
OTHER LOANS AMORTIZATION	0.00	0.00	0.00	0.00	0.00	0.00	13.00	27.00	150.00	280.00
TOTAL AMORTIZATION	0.00	0.00	0.00	0.00	0.00	204.07	421.14	560.16	808.19	938.19
OPER.INTEREST LONG T.DEBT	0.00	0.00	0.00	0.00	0.00	77.14	591.39	600.92	1259.89	1175.96
TOTAL DEBT SERVICE	0.00	0.00	0.00	0.00	0.00	281.21	1012.53	1161.08	2068.08	2114.15
INCREASE IN WORK.CAPITAL	19.17	-15.95	159.60	-219.00	-202.39	156.03	405.21	63.40	91.68	514.88
OTHER ASSETS	0.00	10.55	-6.88	44.97	3.82	-19.44	-20.58	9.87	0.73	-9.38
TOTAL APPLICATIONS	159.17	1049.60	520.30	4938.10	5716.48	4702.03	3359.97	4243.40	4465.20	3986.05
DEBT SERVICE RATIO	0.00	0.00	0.00	0.00	0.00	3.74	1.62	1.76	1.22	1.44
% CONTRIBUTION TO INVESTMENT	13.20	11.30	7.58	8.23	11.94	18.97	20.43	36.50	20.08	55.14
% INTERNAL CASH RATIO	38.88	4.86	9.87	4.55	4.71	4.44	3.09	3.57	1.56	2.88

CHANGWON CITY WATER — BALANCE SHEET — MILLION WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
A S S E T S										
FIXED ASSETS IN OPER.	52.12	622.76	1009.66	2262.13	3626.02	14809.12	18812.93	22897.40	30666.82	35510.56
MINUS ACCUM.DEPRECIATION	0.97	10.92	36.33	88.21	182.11	465.77	997.80	1704.01	2657.42	3896.07
NET FIXED ASSETS	51.15	611.84	973.32	2173.93	3443.91	14343.35	17815.13	21193.39	28009.40	31614.49
WORK IN PROGRESS	100.00	600.00	699.00	4700.00	9500.00	3000.00	2588.00	3582.00	636.00	532.00
CASH AND BANKS	26.48	89.50	180.36	313.44	116.55	39.61	174.97	241.47	249.11	589.61
ACCOUNTS RECEIVABLE	3.39	6.90	16.42	30.50	51.80	114.48	192.43	256.26	331.33	412.05
INVENTARIES	0.10	2.14	4.95	7.55	12.09	22.95	46.10	60.12	75.10	91.82
TOTAL CURRENT ASSETS	29.97	98.53	201.74	351.49	180.45	177.04	413.50	557.85	655.54	1093.48
OTHER ASSETS	0.00	10.55	3.67	48.64	52.47	33.02	12.44	22.31	23.05	13.66
TOTAL ASSETS	181.12	1320.92	1877.73	7274.06	13176.82	17553.42	20829.07	25355.55	29323.98	33253.64
EQUITY AND LIABILITIES										
EQUITY	116.11	963.64	1100.00	2200.00	3600.00	4210.00	5400.00	5700.00	5800.00	5800.00
CONTRIBUTIONS	0.00	143.20	319.40	503.70	733.70	1012.70	1339.70	1636.70	1886.70	2132.70
REVALUATION SURPLUS	2.01	17.35	133.60	269.86	509.00	887.83	2465.60	4425.26	6756.53	9837.57
OPERATIONAL SURPLUS	61.00	110.22	251.99	517.72	1043.04	1752.73	2323.51	3172.54	3661.88	4579.63
TOTAL EQUITY	179.12	1234.41	1804.99	3491.29	5885.74	7863.26	11528.81	14934.50	18105.11	22349.90
LONG TERM DEBT(NET)	0.00	0.00	42.63	3383.90	6656.80	8998.24	8638.07	9429.88	10091.69	9853.50
ACCOUNT PAYABLES	2.00	86.51	30.11	398.86	430.22	270.78	102.02	182.97	188.99	112.04
CURRENT MATURITIES	0.00	0.00	0.00	0.00	204.07	421.14	560.16	808.19	938.19	938.19
TOTAL CURRENT LIABILITIES	2.00	86.51	30.11	398.86	634.29	691.92	662.19	991.17	1127.18	1050.24
TOTAL LIABILITIES	2.00	86.51	72.74	3782.77	7291.09	9690.16	9300.26	10421.05	11218.87	10903.74
TOTAL EQUITY-LIABILITIES	181.12	1320.92	1877.73	7274.06	13176.82	17553.42	20829.07	25355.55	29323.98	33253.64
*WORKING CAPITAL-MILLION	27.97	12.02	171.62	-47.37	-249.77	-93.74	311.47	374.87	466.55	981.43
*CURRENT RATIO	14.99	1.14	6.70	0.88	0.28	0.26	0.62	0.56	0.58	1.04
% DEBT/(DEBT+EQUITY)	0.00	0.00	2.31	49.22	53.07	53.37	42.83	38.70	35.79	30.60

CHANGWON CITY WATER — MONITORING INDICATORS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION AND POPULATION SERVED										
POPULATION-THOUSAND	94.90	119.00	143.20	167.40	191.60	215.80	240.00	258.60	276.00	293.90
POPULATION WITH WATER	13.18	35.92	51.14	68.73	103.91	142.65	175.09	201.67	221.78	241.47
% WITH WATER	13.89	30.18	35.71	41.06	54.23	66.10	72.95	77.98	80.36	82.16
DEMAND										
CONNECTIONS- WATER	1.03	2.80	4.00	5.40	8.26	11.28	13.87	16.02	17.70	19.31
CONSUMPTION-MILLION M3	0.57	1.28	1.90	2.73	3.56	6.92	9.71	12.32	15.00	17.68
CONSUMPTION/CONN/ M3/MONTH	46.12	38.10	39.58	42.13	35.94	51.12	58.34	64.09	70.62	76.30
% UNACCOUNTED FOR WATER	20.00	20.00	25.00	25.00	25.00	25.00	25.00	25.00	24.00	23.00
PRODUCTION-MILLION M3	0.71	1.60	2.53	3.64	4.75	9.23	12.95	16.43	19.74	22.96
PER CAPITA PRODUCTION-LCD	148.08	122.05	135.72	145.10	125.24	177.21	202.58	223.17	243.82	260.52
COSTS										
EXCHANGE RATE 1US$ =	484.00	605.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00
COST US$/ M3 SOLD	0.10	0.08	0.09	0.08	0.10	0.13	0.15	0.16	0.17	0.19
INFLATION (%)	20.00	30.00	19.00	14.00	11.00	11.00	11.00	11.00	11.00	11.00
TOTAL INVESTMENT MILLION US$	0.29	1.74	0.56	7.75	8.96	6.49	2.97	4.56	3.49	2.07
ACCUM.PROJECT INVEST.US$	0.00	0.00	0.22	7.31	14.92	18.79	0.00	0.00	0.00	0.00
ACCUM. % PROJECT INVEST.	0.00	0.00	1.16	38.91	79.40	100.00	0.00	0.00	0.00	0.00
REVENUES										
OPERATING REVENUES-MILLION	32.55	84.10	200.25	371.92	631.74	1396.10	2346.70	3125.09	4040.64	5025.01
AVERAGE TARIFF $/ M3 SOLD	55.00	63.77	103.29	134.00	175.00	200.00	240.00	251.96	267.71	282.64
AVERAGE TARIFF US $/ M3 SOLD	0.11	0.11	0.16	0.20	0.27	0.30	0.36	0.38	0.41	0.43
% INCREASE IN TARIFFS		15.95	61.97	29.73	30.60	14.29	20.00	4.98	6.25	5.58
ANALYSIS IN CONSTANT (1982) PRICES										
CONSTANT PRICE INDEX	60.41	69.47	86.00	100.00	112.40	124.77	138.49	153.72	170.63	189.40
AVERAGE TARIFF/VOLUME SOLD	91.04	91.79	120.11	134.00	155.69	160.30	173.30	163.90	156.89	149.22
TARIFF INCREASE		0.82	30.85	11.57	16.19	2.96	8.11	-5.42	-4.28	-4.89
OPERATING COSTS-MILLION	44.35	94.11	124.59	151.80	205.51	471.89	673.66	838.07	999.82	1147.88
% INCREASE OPERATING COSTS		112.22	32.38	21.85	35.38	129.62	42.76	24.41	19.30	14.81
FINANTIAL RATIOS										
% RATE OF RETURN	15.92	3.47	12.61	15.38	14.94	6.88	6.34	7.00	7.00	7.00
% OPERATING RATIO	82.30	77.75	53.50	40.82	36.57	42.17	39.76	41.22	42.22	43.27
DEBT SERVICE RATIO	**********					3.74	1.62	1.76	1.22	1.44
% RECEIVABLES IN BILLING	10.41	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
% DEBT/(DEBT+EQUITY)	0.00	0.00	2.31	49.22	53.07	53.37	42.83	38.70	35.79	30.60

JINHAE CITY WATER — INCOME STATEMENT — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION-THOUSAND	112.00	115.36	118.82	122.39	126.06	129.84	133.73	137.75	141.88	146.13
POPULATION SERVED- WATER	85.35	87.26	89.34	92.46	95.80	98.62	101.18	104.65	108.58	113.53
% POPULATION SERVED- WATER	76.21	75.64	75.19	75.55	76.00	75.96	75.66	75.98	76.53	77.69
CONNECTIONS- WATER	9.23	9.51	9.84	10.21	10.59	11.02	11.44	11.97	12.58	13.18
VOLUME SOLD-MILLION M3	3.24	3.41	3.73	4.04	4.22	4.71	5.07	5.68	6.30	6.89
CONSUMPTION/CONNEC/MONTH	29.25	29.88	31.59	32.97	33.20	35.62	36.93	39.54	41.73	43.56
% UNACCOUNTED FOR WATER	25.00	25.00	24.80	24.00	23.00	22.00	21.00	20.00	20.00	20.00
PRODUCTION-MILL. M3	4.32	4.55	4.96	5.32	5.48	6.04	6.42	7.10	7.88	8.61
PER CAPITA PRODUCTION LCD	138.67	142.75	152.12	157.51	156.72	167.75	173.77	185.87	198.71	207.84
AVERAGE WATER TARIFF / M3	57.00	70.00	94.00	135.00	160.00	180.00	200.00	233.39	253.83	277.82
WATER REVENUES	184.68	238.70	350.62	545.40	675.14	847.80	1014.00	1325.63	1599.13	1914.15
OTHER OPERATIONAL REVENUE	14.40	2.48	19.38	25.80	29.10	33.10	37.40	42.70	48.90	54.60
TOTAL REVENUES	199.08	241.18	370.00	571.20	704.24	880.90	1051.40	1368.33	1648.03	1968.75
WAGES- WATER	23.90	40.00	52.39	63.33	73.90	84.69	95.80	108.80	122.62	138.05
CHEMICALS	6.39	11.00	12.85	15.42	17.81	21.98	26.12	32.38	40.24	49.35
POWER	26.00	44.00	64.98	86.12	105.22	139.49	173.92	230.04	303.98	396.18
MATERIALS	10.80	18.00	16.14	18.17	20.54	23.36	26.43	30.16	34.47	39.41
MOC RAW WATER	4.00	6.00	12.90	14.00	15.30	16.70	18.20	19.80	21.60	22.90
OTHER COST	3.60	6.15	8.06	9.91	11.57	13.36	15.40	17.88	20.86	24.26
DIRECT COSTS-WATER	74.69	125.15	167.31	206.95	244.34	299.59	355.87	439.07	543.76	670.15
OTHER INDIRECT COSTS	3.70	0.00	7.01	10.91	13.50	16.96	20.28	24.76	29.61	35.14
TOTAL COSTS	78.39	125.15	174.32	217.86	257.84	316.54	376.15	463.83	573.37	705.29
INCOME BEFORE DEPRECIATION	120.69	116.03	195.68	353.34	446.39	564.36	675.25	904.50	1074.65	1263.47
DEPRECIATION	53.73	72.13	91.38	110.94	144.39	208.91	278.06	337.56	407.27	486.68
INCOME BEFORE INTEREST	66.96	43.90	104.30	242.40	302.00	355.45	397.19	566.94	667.38	776.79
INTEREST CHARGED OPER.	22.80	22.50	22.00	20.90	19.30	35.84	154.61	155.62	258.79	238.55
NON OPER.REVENUES (+)	10.80	0.22	16.17	19.61	22.04	27.09	28.98	335.75	305.00	274.40
NET SURPLUS (+)	54.96	21.62	98.47	241.11	304.74	346.70	271.57	747.07	713.59	812.63
AVERAGE RATE BASE	1262.33	1629.16	1967.92	2286.41	2965.56	4458.25	5973.35	7086.78	8342.27	9709.83
*OPERATING RATIO %	39.38	51.89	47.11	38.14	36.61	35.93	35.78	33.90	34.79	35.82
*RATE OF RETURN %	5.30	2.69	5.30	10.60	10.13	7.97	6.65	8.00	8.00	8.00

JINHAE CITY WATER — FLOW OF FUNDS — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SOURCES OF FUNDS										
INCOME BEFORE DEPRECIATION	120.69	116.03	195.68	353.34	446.39	564.36	675.25	904.50	1074.65	1263.47
NON-OPER.REVENUES (NET)	10.80	0.22	16.17	19.61	22.04	27.09	28.98	335.75	305.00	274.40
GRANTS FOR OPERATION	0.00	50.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GROSS INTERNAL GENERATION	131.49	166.79	211.85	372.95	468.43	591.45	704.23	1240.25	1379.65	1537.87
OTHER CONTRIBUTIONS	26.30	29.70	39.36	48.22	82.33	66.20	70.50	97.00	123.40	130.20
IBRD LOAN	0.00	0.00	0.00	583.54	533.66	28.20	0.00	0.00	0.00	0.00
NATIONAL LOANS	0.00	0.00	13.48	357.22	616.93	212.02	24.38	26.33	9.66	0.00
TOTAL LOANS	0.00	0.00	13.48	940.76	1150.59	240.22	24.38	26.33	9.66	0.00
TOTAL SOURCES	157.79	196.49	264.68	1361.93	1701.35	897.87	799.11	1363.58	1512.71	1668.07
APPLICATIONS OF FUNDS										
INVESTMENT IN PROJECT	0.00	0.00	43.29	1297.97	1394.92	199.09	0.00	0.00	0.00	0.00
CAPITALIZED INTEREST	0.00	0.00	0.11	68.14	191.84	253.48	140.72	128.13	9.66	0.00
SERVICE CONNECTIONS	28.50	36.70	32.56	47.20	53.00	64.90	70.00	94.30	120.70	129.50
OTHER WORKS	109.02	89.12	0.00	0.00	0.00	0.00	210.25	708.70	800.30	917.50
TOTAL INVESTMENT	137.52	125.82	75.95	1413.31	1639.76	517.47	420.97	931.13	930.66	1047.00
FOREIGN LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	47.73	95.45	95.45	95.45	95.45
NATIONAL LOAN AMORTIZATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.83	177.00	242.19
OTHER LOANS AMORTIZATION	11.50	15.00	20.70	28.70	28.70	28.70	28.70	28.70	28.70	28.70
TOTAL AMORTIZATION	11.50	15.00	20.70	28.70	28.70	76.43	124.15	153.98	301.15	366.34
OPER.INTEREST LONG T.DEBT	22.80	22.50	22.00	20.90	19.30	35.84	154.61	155.62	258.79	238.55
TOTAL OPERATIONAL INTEREST	22.80	22.50	22.00	20.90	19.30	35.84	154.61	155.62	258.79	238.55
TOTAL DEBT SERVICE	34.30	37.50	42.70	49.60	48.00	112.27	278.76	309.60	559.95	604.90
INCREASE IN WORK.CAPITAL	-15.03	20.37	113.65	-206.98	2.93	403.41	98.15	119.15	17.01	12.27
OTHER ASSETS	1.00	12.80	32.38	106.00	10.66	-135.28	1.24	3.70	5.10	3.90
TOTAL APPLICATIONS	157.79	196.49	264.68	1361.93	1701.35	897.87	799.11	1363.58	1512.71	1668.07
DEBT SERVICE RATIO	3.83	4.45	4.96	7.52	9.76	5.27	2.53	4.01	2.46	2.54
% CONTRIBUTION TO INVESTMENT	72.74	114.32	31.42	31.00	35.33	55.76	68.27	122.31	84.54	92.54

JINHAE CITY WATER — BALANCE SHEET — MILL WON

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
A S S E T S										
FIXED ASSETS IN OPER.	1737.34	2384.36	2837.38	3502.18	4748.88	7188.73	8700.46	10588.64	12684.04	15126.29
MINUS ACCUM.DEPRECIATION	243.23	388.32	553.49	741.92	967.92	1283.30	1702.52	2227.36	2879.64	3683.08
NET FIXED ASSETS	1494.11	1996.03	2283.90	2760.27	3780.96	5905.43	6997.94	8361.28	9804.40	11443.21
WORK IN PROGRESS	0.00	0.00	75.95	1221.70	2000.00	600.00	300.00	300.00	300.00	300.00
CASH AND BANKS	7.17	31.00	159.45	7.65	6.19	301.08	377.67	471.19	466.26	452.43
ACCOUNTS RECEIVABLE	20.36	22.59	30.34	46.84	57.75	72.23	86.21	112.20	135.14	161.44
INVENTARIES	3.44	3.95	4.75	5.51	6.29	7.44	8.62	10.26	12.25	14.56
TOTAL CURRENT ASSETS	30.97	57.54	194.54	60.00	70.22	380.75	472.50	593.65	613.65	628.42
OTHER ASSETS	1.00	13.80	46.18	152.18	162.84	27.56	28.80	32.50	37.60	41.50
TOTAL ASSETS	1526.08	2067.37	2600.57	4194.15	6014.02	6913.74	7799.23	9287.42	10755.65	12413.13
EQUITY AND LIABILITIES										
EQUITY	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
CONTRIBUTIONS	81.30	161.54	200.90	249.12	331.45	397.65	468.15	565.15	688.55	818.75
REVALUATION SURPLUS	841.03	1289.27	1668.51	1988.26	2291.89	2707.79	3357.39	4127.16	5046.91	6125.39
OPERATIONAL SURPLUS	204.25	225.87	324.33	565.44	870.18	1216.88	1488.45	2235.52	2949.11	3761.74
TOTAL EQUITY	1176.58	1726.67	2243.75	2852.82	3543.52	4372.33	5363.99	6977.83	8734.56	10755.88
LONG TERM DEBT(NET)	332.50	311.80	296.58	1208.63	2282.80	2398.87	2269.26	1994.43	1637.75	1397.24
ACCOUNT PAYABLES	2.00	8.20	31.55	103.99	111.28	18.40	12.00	14.00	17.00	19.50
CURRENT MATURITIES	15.00	20.70	28.70	28.70	76.43	124.15	153.98	301.15	366.34	240.50
TOTAL CURRENT LIABILITIES	17.00	28.90	60.25	132.69	187.71	142.55	165.98	315.15	383.34	260.00
SHORT TERM DEBT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL LIABILITIES	349.50	340.70	356.83	1341.32	2470.50	2541.42	2435.24	2309.59	2021.09	1657.25
TOTAL EQUITY-LIABILITIES	1526.08	2067.37	2600.57	4194.15	6014.02	6913.74	7799.23	9287.42	10755.65	12413.13
*WORKING CAPITAL-MILLION	28.97	49.34	162.99	-43.99	-41.06	362.35	460.50	579.65	596.65	608.92
*CURRENT RATIO	1.82	1.99	3.23	0.45	0.37	2.67	2.85	1.88	1.60	2.42
% DEBT/(DEBT+EQUITY)	22.03	15.30	11.67	29.76	39.18	35.43	29.73	22.23	15.79	11.50

JINHAE CITY WATER — MONITORING INDICATORS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
POPULATION AND POPULATION SERVED										
POPULATION-THOUSAND	112.00	115.36	118.82	122.39	126.06	129.84	133.73	137.75	141.88	146.13
POPULATION WITH WATER	85.35	87.26	89.34	92.46	95.80	98.62	101.18	104.65	108.58	113.53
% WITH WATER	76.21	75.64	75.19	75.55	76.00	75.96	75.66	75.98	76.53	77.69
DEMAND										
CONNECTIONS- WATER	9.23	9.51	9.84	10.21	10.59	11.02	11.44	11.97	12.58	13.18
CONSUMPTION-MILLION M3	3.24	3.41	3.73	4.04	4.22	4.71	5.07	5.68	6.30	6.89
CONSUMPTION/CONN/ M3/MONTH	29.25	29.88	31.59	32.97	33.20	35.62	36.93	39.54	41.73	43.56
% UNACCOUNTED FOR WATER	25.00	25.00	24.80	24.00	23.00	22.00	21.00	20.00	20.00	20.00
PRODUCTION-MILLION M3	4.32	4.55	4.96	5.32	5.48	6.04	6.42	7.10	7.88	8.61
PER CAPITA PRODUCTION-LCD	138.67	142.75	152.12	157.51	156.72	167.75	173.77	185.87	198.71	207.84
COSTS										
EXCHANGE RATE 1US$ =	484.00	605.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00	660.00
COST US$/ M3 SOLD	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.16
INFLATION (%)	20.00	30.00	19.00	14.00	11.00	11.00	11.00	11.00	11.00	11.00
TOTAL INVESTMENT MILLION US$	0.28	0.21	0.12	2.14	2.48	0.78	0.64	1.41	1.41	1.59
ACCUM.PROJECT INVEST.US$	0.00	0.00	0.07	2.03	4.15	4.45	0.00	0.00	0.00	0.00
ACCUM. % PROJECT INVEST.	0.00	0.00	1.47	45.69	93.22	100.00	0.00	0.00	0.00	0.00
REVENUES										
OPERATING REVENUES-MILLION	199.08	241.18	370.00	571.20	704.24	880.90	1051.40	1368.33	1648.03	1968.75
AVERAGE TARIFF $/ M3 SOLD	57.00	70.00	94.00	135.00	160.00	180.00	200.00	233.39	253.83	277.82
AVERAGE TARIFF US $/ M3 SOLD	0.12	0.12	0.14	0.20	0.24	0.27	0.30	0.35	0.38	0.42
% INCREASE IN TARIFFS		22.81	34.29	43.62	18.52	12.50	11.11	16.69	8.76	9.45
ANALYSIS IN CONSTANT (1982) PRICES										
CONSTANT PRICE INDEX	60.41	69.47	86.00	100.00	112.40	124.77	138.49	153.72	170.63	189.40
AVERAGE TARIFF/VOLUME SOLD	94.35	100.76	109.31	135.00	142.35	144.27	144.41	151.82	148.76	146.68
TARIFF INCREASE		6.79	8.49	23.51	5.44	1.35	0.10	5.13	-2.02	-1.40
OPERATING COSTS-MILLION	129.76	180.14	202.71	217.86	229.39	253.71	271.60	301.73	336.03	372.37
% INCREASE OPERATING COSTS		38.83	12.53	7.48	5.29	10.60	7.05	11.09	11.37	10.82
FINANTIAL RATIOS										
% RATE OF RETURN	5.30	2.69	5.30	10.60	10.18	7.97	6.65	8.00	8.00	8.00
% OPERATING RATIO	39.38	51.89	47.11	38.14	36.61	35.93	35.78	33.90	34.79	35.82
DEBT SERVICE RATIO	3.83	4.45	4.96	7.52	9.76	5.27	2.53	4.01	2.46	2.54
% RECEIVABLES IN BILLING	10.23	9.37	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
% DEBT/(DEBT+EQUITY)	22.03	15.30	11.67	29.76	39.18	35.43	29.73	22.23	15.79	11.50

KOREA

FIRST WATER SUPPLY PROJECT

Assumptions in Financial Forecasts

Revenues

1. Sales were calculated following the assumptions for demand, production and unaccounted for water presented in Annex 6. Tariffs were increased on April 1, 1981 and the average tariffs charged in 1981 as a result of this increase are as follows (average tariffs won/cu m).

	Gwangju	Daegu	Masan	Changwon	Jinhae
Previous tariff 1980	103	84	99	64	70
Average tariff 1981	156	102	160	103	94
% increase	51	21	62	61	34

2. A large tariff increase in the earlier part of the project construction was necessary to generate the funds required and to better reflect the actual production costs.

3. A meter maintenance charge is customarily added to the water bills. It has been assumed that it will be adjusted in line with the inflation rate.

4. It is usual practice in Korea to charge new users with a connection fee in addition to the actual cost of construction and the meter. It has been assumed that both costs will increase in line with inflation. Since new connections in Gwangju will serve mostly low income areas, the construction costs have been included in the project and it was assumed to be recovered through the water tariffs and not by charging directly the new customers. This procedure was considered advisable for Gwangju only given its relatively less developed economy and it is expected to help avoid delays in getting new customers connected to the system.

Operating Costs

5. It was assumed that labor costs should reflect various degrees of adjustments in the bureaus to correct present weaknesses and to handle a larger level of operations. The following inflation rates were used to escalate the operating costs: 19% in 1981, 14% in 1982, and 11% in 1983 and thereafter.

6. Cost of chemicals and power was projected to increase faster than the general inflation level (3% for chemicals and 5% for power); additionally they reflect the new operating characteristics of each system.

7. It is expected that by 1984 the Government will have implemented a charge to those who extract water from the Nakdong River. The charge was assumed to be periodically adjusted for inflation.

Working Capital

8. There is no reliable data on the present level of accounts receivable. Nevertheless, it is clear that collection procedures are tight and strictly enforced. Accordingly, it was considered that 30 days of billing was an adequate assumption.

9. Inventories are projected to reflect the requirements and practices of each system.

10. Accounts payable were estimated considering the level of investment program of each bureau and their inventory requirements.

11. Other assets mostly include advances to contractors.

Debt

12. IBRD loan was assumed to be passed to the municipalities to cover 100% of the foreign component, with an interest rate of 11.6% p.a., 0.75% commitment fee and a repayment period of 15 years including 3 years grace period. A further 1% has been provided in the projections to cover the possibility of foreign loan revaluation due to currency devaluation. The funds provided by this additional 1% will be used to pay any additional annual charge arising from loan revaluation or, if not so required, will be held by the municipalities in reserve against future liabilities.

13. Government loans were assumed to finance 50% of the local components of all projects except for Gwangju for which a special government decision increased it to 70%. Interest rate was assumed to remain as at present 13% and as well as the repayment period of 20 years including 5 years of grace period.

14. City bonds were assumed to be issued, following the present practice, at 8% interest p.a. and repayment of interest and principal at the end of five years.

15. Changwon, instead of issuing city bonds, is planning to allocate from its Urban Development fund the amounts required for the project.

KOREA

FIRST WATER SUPPLY PROJECT

Economic Evaluation

1. The internal rate of return was computed using border prices, instead of domestic prices. The following conversion factors were used.

Standard	:	0.89
Skilled labor	:	0.89
Semiskilled labor	:	0.81
Unskilled labor	:	0.86
Investment	:	0.87
Electricity	:	0.89
Consumption	:	0.87

2. All costs are expressed in January 1981 prices and include engineering, administration and physical contingencies. Taxes and customs duties have been deducted.

3. Incremental revenues from consumer charges were used as a proxy for economic benefits of the project. For this purpose, the average water rates assumed to be effective at the end of the project construction were deflated to January 1981 prices. Following negotiations tariff increases up to 1985 were smoothed. Nevertheless as the forecast tariffs were modified by less than 4% for 1985 and thereafter (which is within the range of the sensitivity analysis), no changes were introduced in the economic evaluation.

4. Given the lumpiness of investment, Average Incremental Cost (AIC) was used to estimate the Long-Run Marginal Cost (LRMC). Since border prices were used to make the resulting AICs comparable with average tariffs, the AICs were converted into domestic prices by dividing them by the conversion factor for consumption. The conversion factor for consumption was used since most of the incremental water sales in the project areas will go to residential consumers.

A. GWANGJU Economic Rate of Return and AIC
(Million won at January 1, 1981 border prices)

Year	Construction cost	Incremental O&M	Incremental revenues	Incremental water sales (million cu m)
1981	6,297	-	-	-
1982	15,137	-	-	-
1983	15,098	-	-	-
1984	6,495	-	1,884	6.64
1985	979	-	3,202	14.79
1986	0	48	3,924	19.33
1987	-	346	4,870	23.94
1988-2015	-	357	5,824	28.60

IRR - 11.55%

Sensitivity:

If investment cost increases by 10%, IRR is	: 10.55%
If investment cost increases by 20%, IRR is	: 9.75%
If O&M cost increases by 20%, IRR is	: 11.45%
If revenues are reduced by 10%, IRR is	: 10.35%
If revenues are reduced by 10% and investment cost increases by 10%, the IRR is	: 9.55%

Average Incremental Cost: (won per cu m)

Discount rate	AIC-border prices	AIC-domestic prices /a
10%	176.92	203.35
12%	213.15	245.00
15%	275.17	316.30

/a AIC at border prices divided by consumption conversion factor of 0.87.

B. DAEGU Incremental Rate of Return and AIC
(Million won at January 1, 1981 border prices)

Year	Construction cost	Incremental O&M	Incremental revenues	Incremental water sales (million cu m)
1981	1,214			
1982	8,820			
1983	11,686			
1984	7,329	2,412	2,517	12.77
1985	2,030	4,149	5,072	27.17
1986		2,940	7,598	41.34
1987		4,081	10,285	57.00
1988-2015		4,892	12,043	67.82

IRR = 16.05

Sensitivity:
If investment cost increases by 10%, IRR is : 14.85%
If investment cost increases by 20%, IRR is : 13.85%
If O&M cost increases by 20%, IRR is : 13.95%
If revenues are reduced by 10%, IRR is : 13.65%
If revenues are reduced by 10% and investment cost increases by 10%, the IRR is : 12.65%

Average Incremental Cost: (won per cu m)

Discount rate	AIC-border prices	AIC-domestic prices /a
10%	136.24	156.60
12%	149.53	171.87
15%	171.47	197.09

/a AIC at border prices divided by consumption conversion factor of 0.87.

C. MASAN Incremental Rate of Return and AIC
(Million won at January 1, 1981 border prices)

Year	Construction cost	Incremental O&M	Incremental revenues	Incremental water sales (million cu m)
1981	2,870			
1982	5,389			
1983	4,692			
1984	2,501		1,054	4.26
1985			1,871	7.76
1986		312	2,691	11.93
1987		285	2,852	12.69
1988-2015		267	2,786	12.69

IRR = 13.15%

Sensitivity:
- If investment cost increases by 10%, IRR is : 12.05%
- If investment cost increases by 20%, IRR is : 11.00%
- If O&M cost increases by 20%, IRR is : 12.95%
- If revenues are reduced by 10%, IRR is : 11.85%
- If revenues are reduced by 10% and investment cost increases by 10%, the IRR is : 10.75%

Average Incremental Cost: (won per cu m)

Discount rate	AIC-border prices	AIC-domestic prices /a
10%	172.7	198.5
12%	203.8	234.3
15%	255.2	293.3

/a AIC at border prices divided by consumption conversion factor of 0.87.

D. CHANGWON Incremental Rate of Return and AIC
(Million won at January 1, 1981 border prices)

Year	Construction cost	Incremental O&M	Incremental revenues	Incremental water sales (million cu m)
1981	1,436			
1982	2,932			
1983	2,677			
1984	941	378	633	3.36
1985		599	1,160	6.15
1986		823	1,617	8.76
1987		1,054	2,081	11.44
1988-2015		1,299	2,568	14.12

IRR = 11.65%

Sensitivity:
If investment cost increases by 10%, IRR is : 10.75%
If investment cost increases by 20%, IRR is : 9.85%
If O&M cost increases by 20%, IRR is : 10.55%
If revenues are reduced by 10%, IRR is : 9.45%
If revenues are reduced by 10% and investment cost increases by 10%, the IRR is : 8.55%

Average Incremental Cost: (won per cu m)

Discount rate	AIC-border prices	AIC-domestic prices /a
10%	168.6	193.8
12%	185.5	213.2
15%	214.0	246.0

/a AIC at border prices divided by consumption conversion factor of 0.87.

E. JINHAE Incremental Rate of Return and AIC
(Million won at January 1, 1981 border prices)

Year	Construction cost	Incremental O&M	Incremental revenues	Incremental water sales (million cu m)
1981	328			
1982	963			
1983	929			
1984	140	35	70	0.49
1985		64	120	0.85
1986		104	205	1.46
1987		149	290	2.08
1988-2015		197	372	2.67

IRR = 10.25%

Sensitivity:

If investment cost increases by 10%, IRR is	: 9.45%
If investment cost increases by 20%, IRR is	: 8.75%
If O&M cost increases by 20%, IRR is	: 9.15%
If revenues are reduced by 10%, IRR is	: 8.85%
If revenues are reduced by 10% and investment cost increases by 10%, the IRR is	: 8.15%

Average Incremental Cost: (won per cu m)

Discount rate	AIC-border prices	AIC-domestic prices /a
10%	143.16	164.55
12%	166.34	191.19
15%	206.95	237.87

/a AIC at border prices divided by consumption conversion factor of 0.87.

KOREA

FIRST WATER SUPPLY PROJECT

Selected Documents and Data in the Project File

A. Reports and Studies

1. Daegu Water Supply Project Master Plan and Feasibility Study - May 1980

   (a) Main Report - Executive Summary; Study Results; Master Plan

   (b) Appendix 1 - Evaluation of Existing System

   (c) Appendix 2 - Evaluation of Surface Water Resources and Water Quality

   (d) Appendix 3 - Water Demand and Design Criteria; Social Implications; Cost Analysis; Groundwater Assessment; Review of Financial History of Waterworks Bureau

   (e) Appendix 4 - Leakage Survey and Repair Program; Preliminary Evaluation of Sanitation; Distribution System Analysis; Stage 1 Water System Alternatives

2. Masan Regional Water Supply Project Master Plan and Feasibility Study - May 1980

   (a) Main Report - Study Results; Master Plan

   (b) Main Report - Feasibility Study

   (c) Appendix 1 - Evaluation of existing system; Review of Organization; Population Projections

   (d) Appendix 2 - Evaluation of Surface Water Resources and Water Quality

   (e) Appendix 3 - Water Demand and Design Criteria; Social Implications; Cost Analysis; Groundwater Assessment; Review of Financial History of Waterworks Bureau

   (f) Appendix 4 - Leakage Survey and Repair Program: Preliminary Evaluation of Sanitation; Distribution System Analysis; Stage 1 Water System Alternatives.

3. Gwuangju Water Supply Project

(a) Master Plan and Feasibility Study Volume 1 - Reports, December 1979
(b) Volume 2 - Background Studies December 1979;
(c) Supplementary Comments - September 1980
(d) Immediate Operation Improvements - July 1979
(e) Main Report - May 1980
(f) Final Draft Report - September 1980
(g) Final Report - October 1980

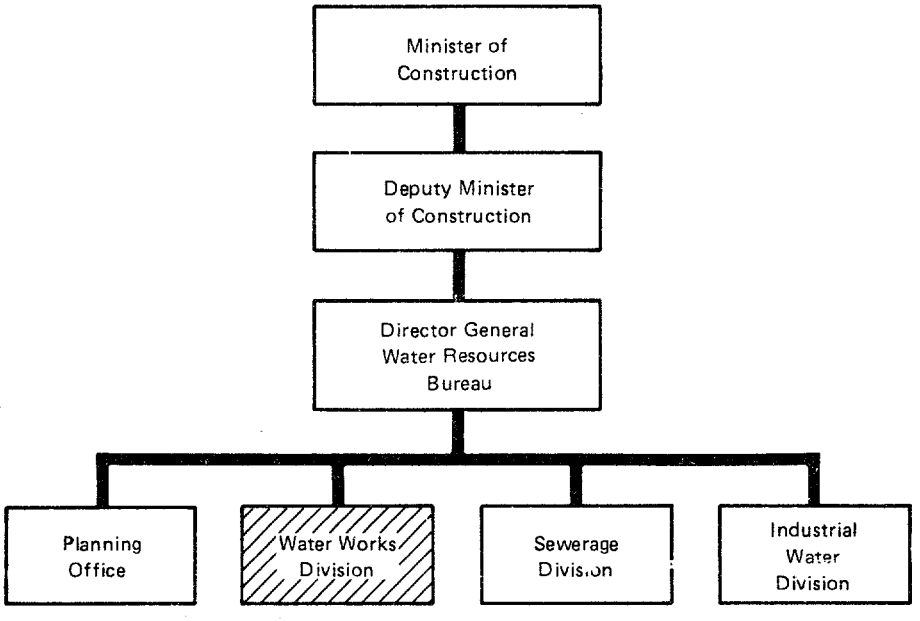
B. Documents Prepared by Staff

(a) Detailed Financial Projections and Monitoring Indicators

C. Other Documents

(a) 1980 Financial Statements for Project Cities

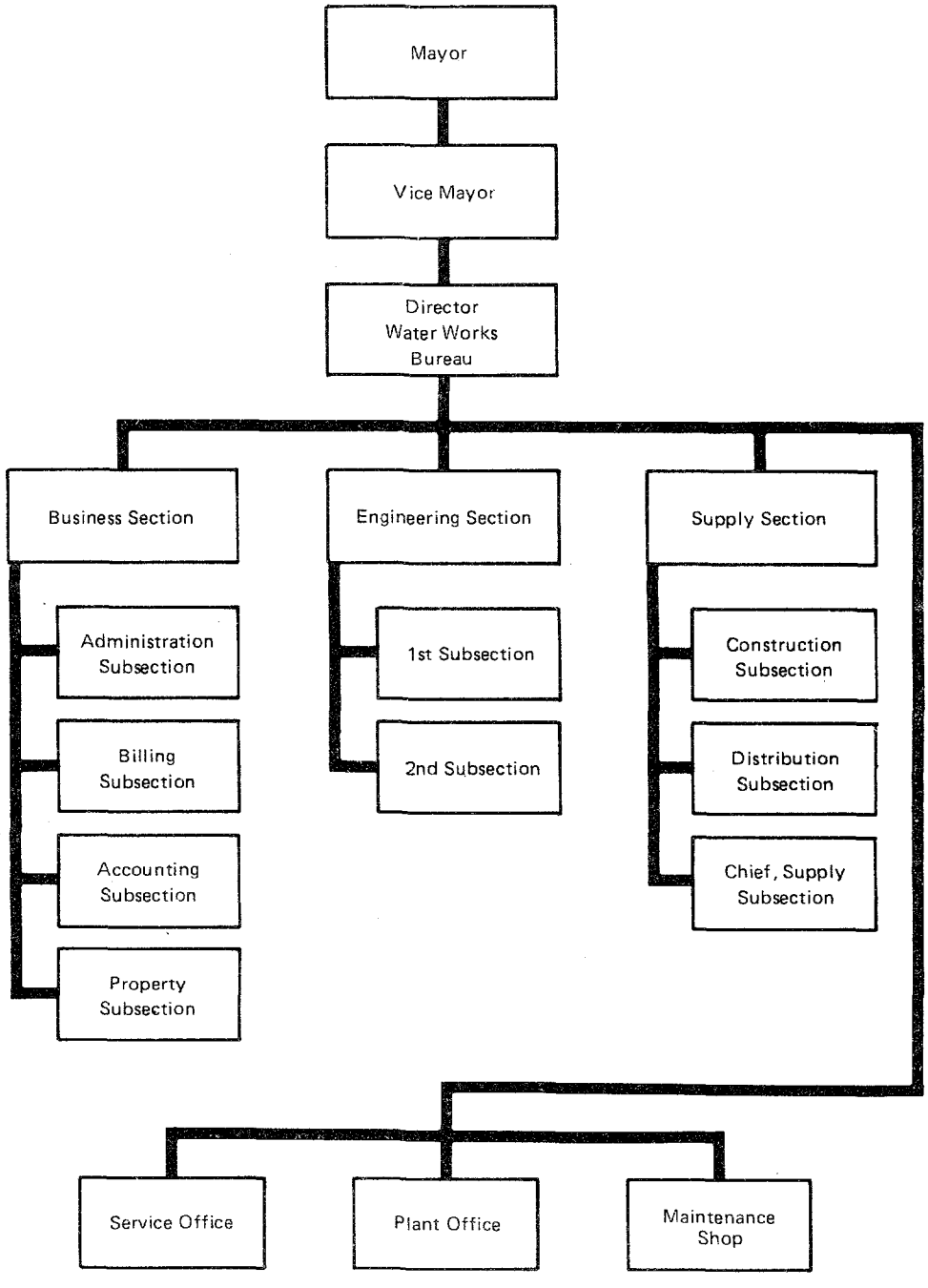
KOREA – FIRST WATER SUPPLY PROJECT
MINISTRY OF CONSTRUCTION
Water Resources Bureau



Water Works Division to be strengthened to prepare and implement projects.

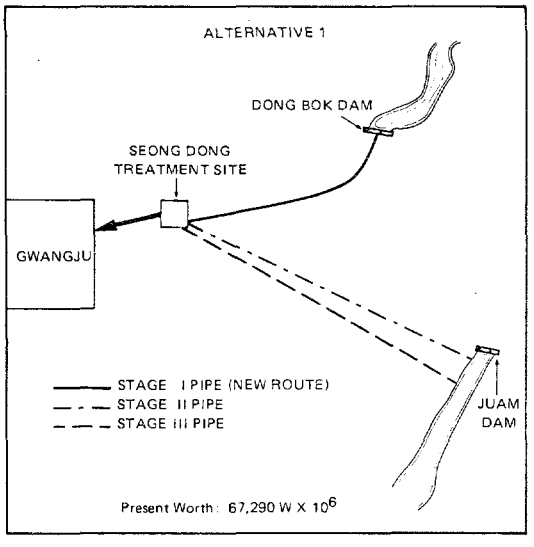
World Bank–22312

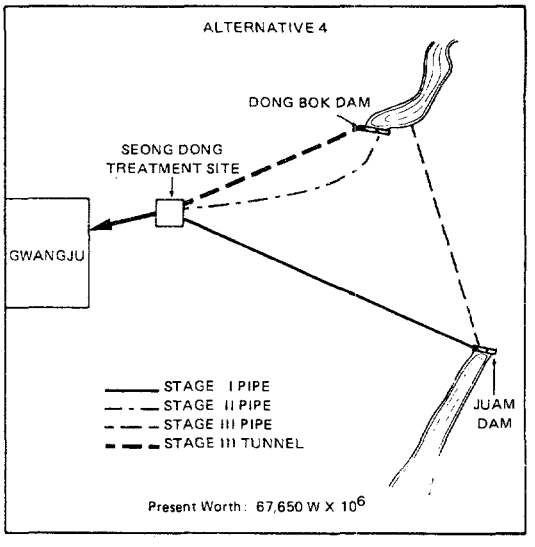
KOREA – FIRST WATER SUPPLY PROJECT
TYPICAL WATER WORKS BUREAU ORGANIZATION CHART

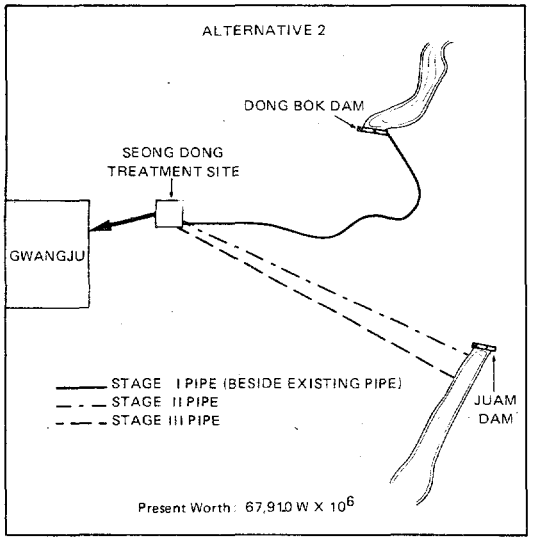


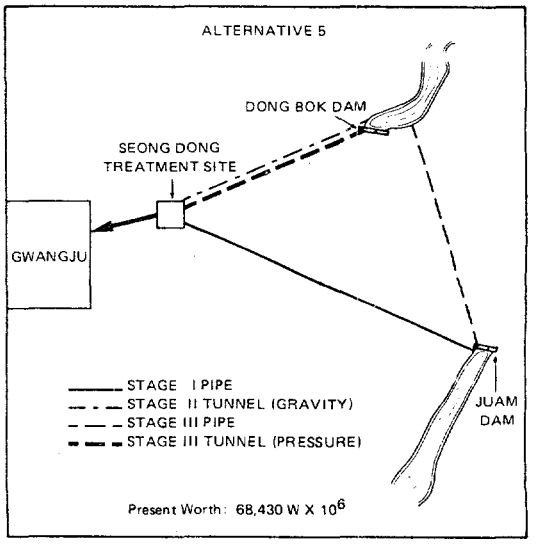
World Bank–22313

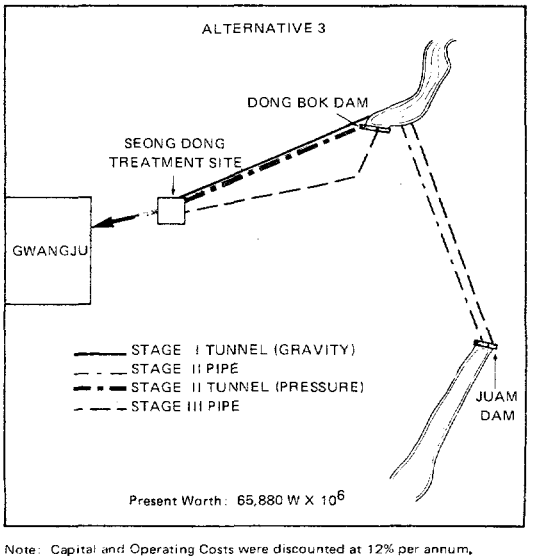
FIRST WATER SUPPLY PROJECT
SIX ALTERNATIVE PROPOSALS FOR SOURCE DEVELOPMENT
IN THREE STAGES (1980–2010) FROM DONG BOK AND JUAM DAMS FOR GWANGJU CITY

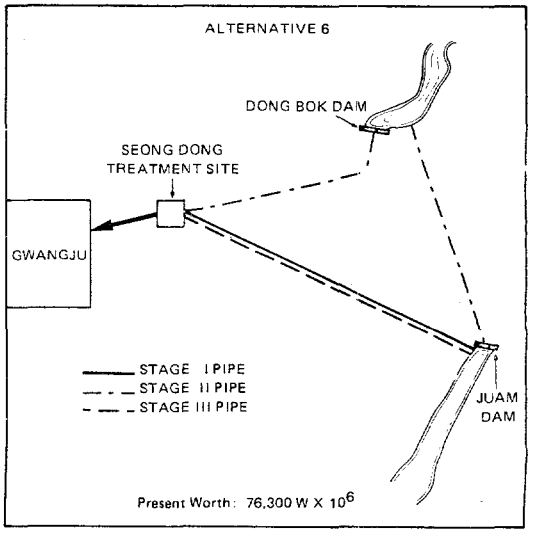








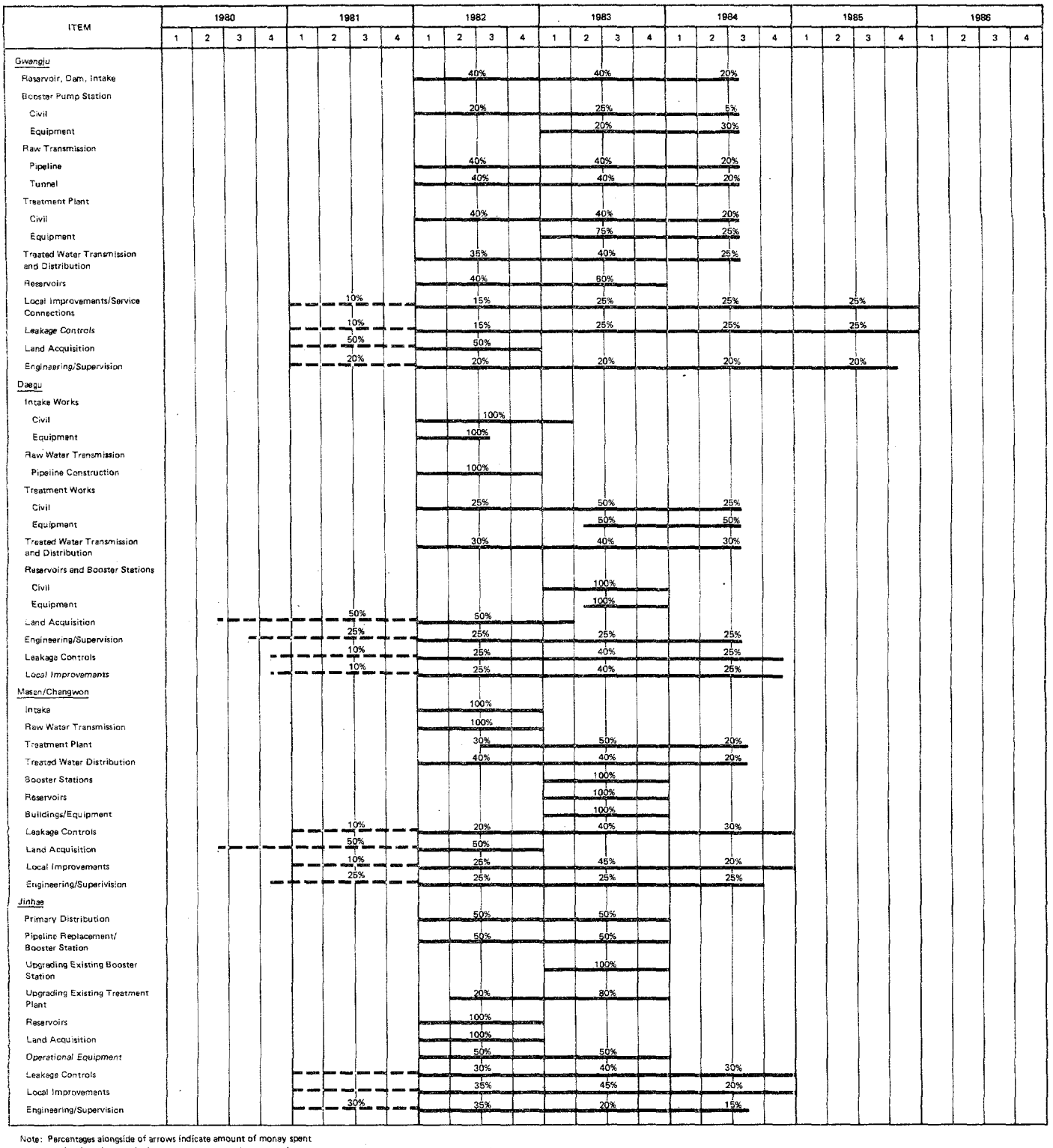




Note: Capital and Operating Costs were discounted at 12% per annum.

World Bank - 22347

KOREA
FIRST WATER SUPPLY PROJECT
IMPLEMENTATION SCHEDULE

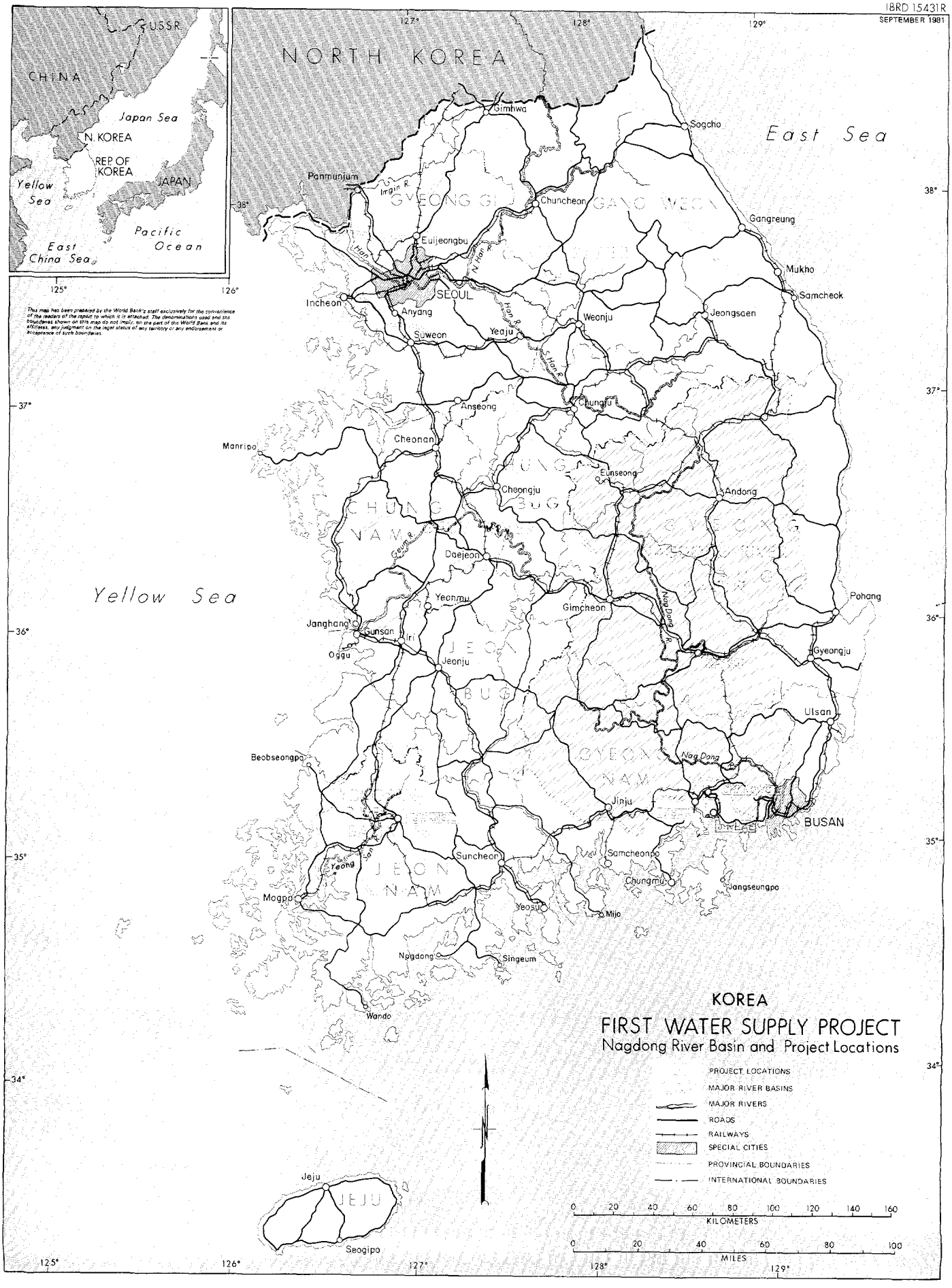


Note: Percentages alongside of arrows indicate amount of money spent on that item in a particular year.

Ongoing Work

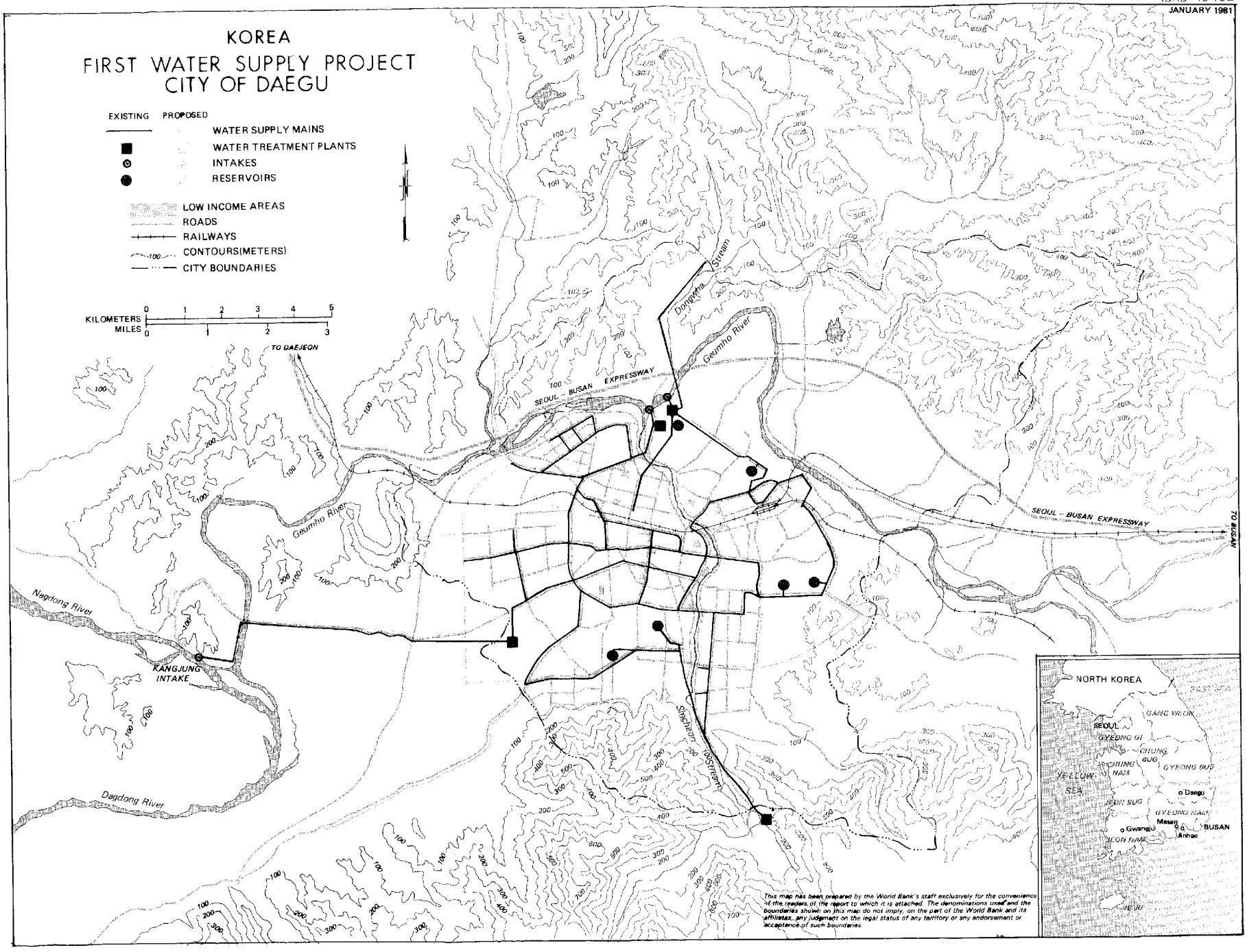
World Bank – 22348

IBRD 15431R
SEPTEMBER 1981



IBRD 15432
JANUARY 1981

KOREA
FIRST WATER SUPPLY PROJECT
CITY OF DAEGU



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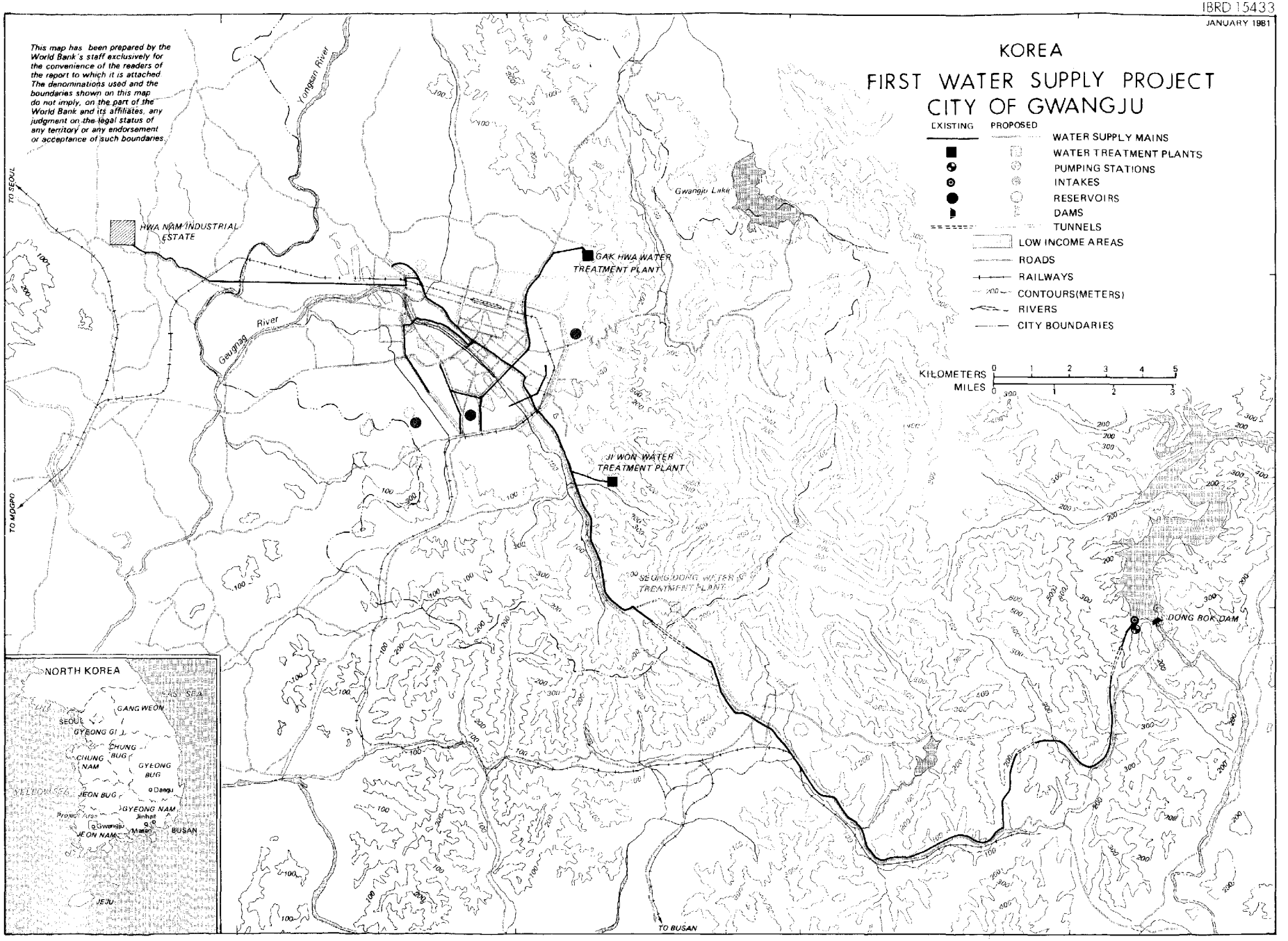
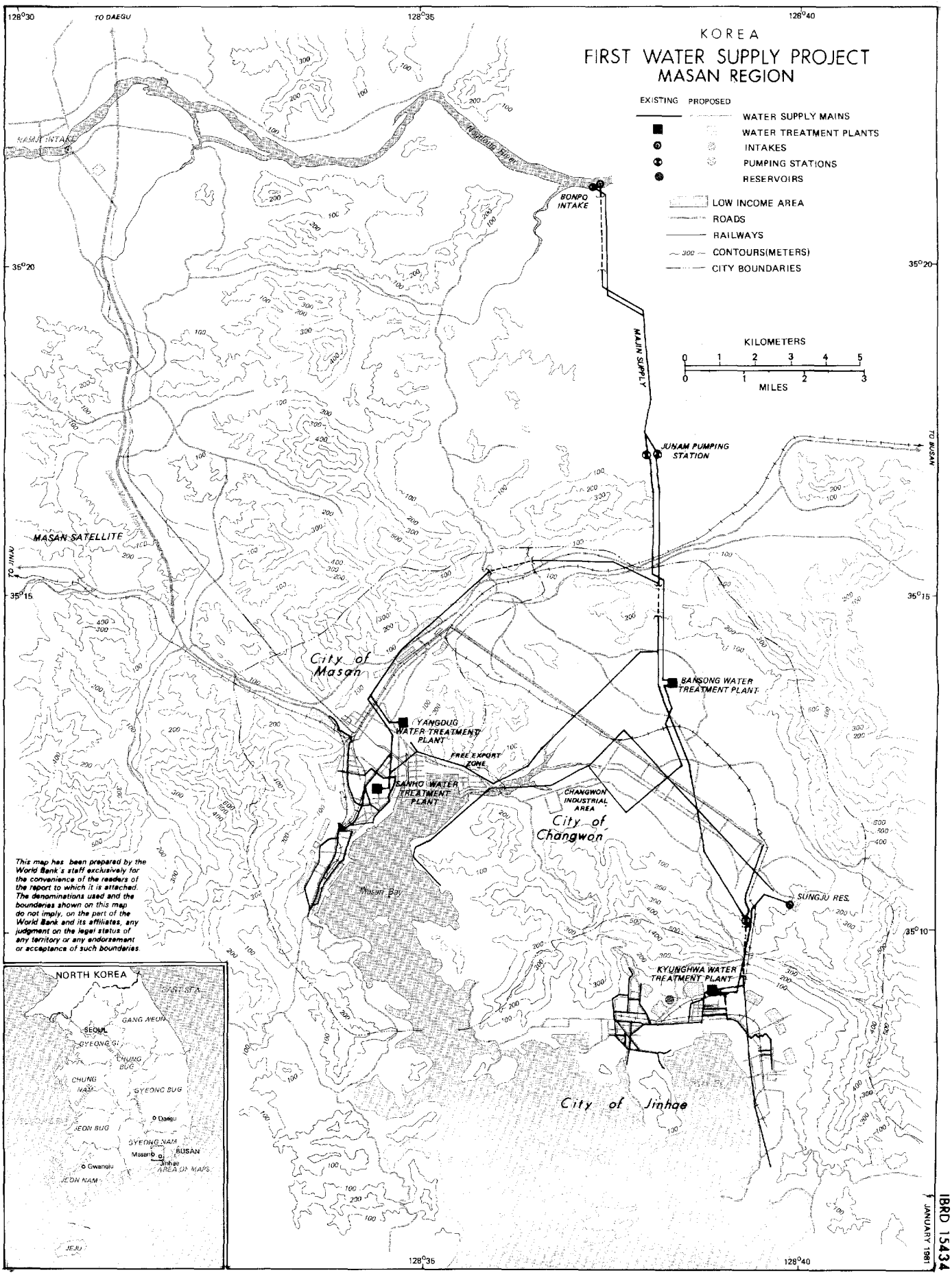
JANUARY 1981





IBRD 15434
JANUARY 1981